PENNSYLVANIA AND ITS MANIFOLD ACTIVITIES

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Foreword

THE occasion for the publication of this book, which is intended to give an understanding of the resources and activities of the State of Pennsylvania, is the meeting of the Twelfth International Congress of Navigation in the City of Philadelphia. Owing to the nature of this gathering, somewhat greater attention has been paid to the subject of transportation than would naturally be given in a general work dealing with the resources and development of the State.

It is impossible to give, within the limits of a single volume, an exhaustive view of the material wealth and the varied interests of Pennsylvania. Much has been omitted; and those subjects only have been selected that seemed to be most in keeping with the purpose of the volume. Liberal excerpts have been used from many and varied volumes and documents. The thanks of those who have had in charge the preparation of the work are extended to all who have lent their aid.

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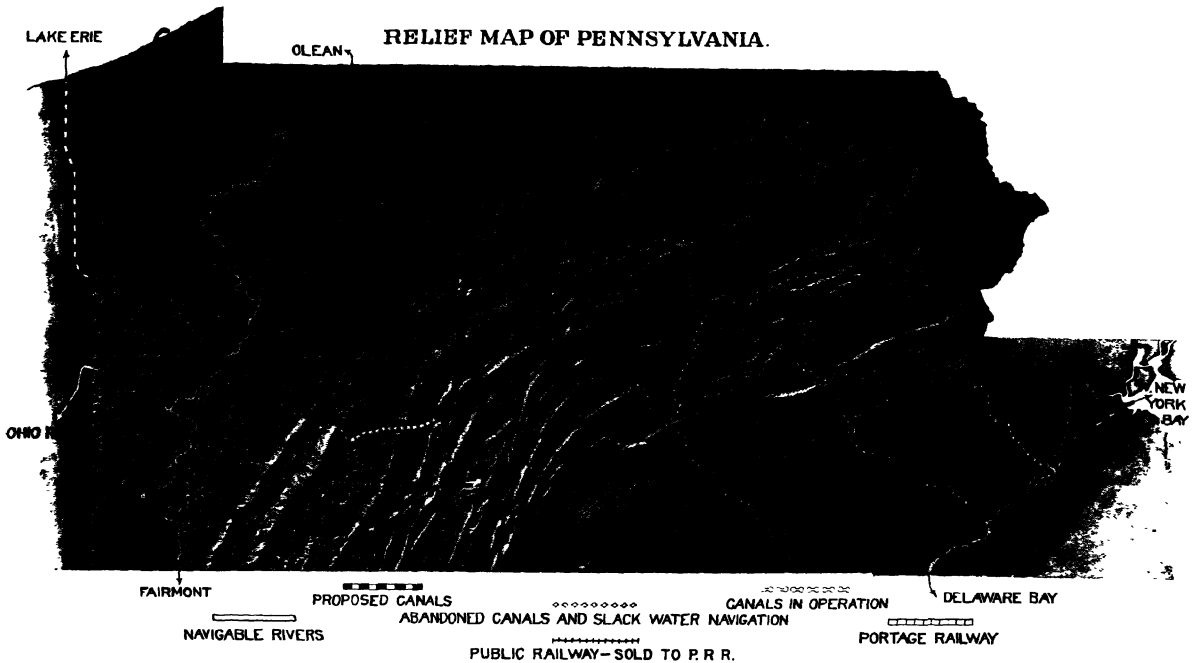
Introduction

THOSE who, in the early days, termed Pennsylvania the Keystone State were, it would seem, governed by something more than the mere thought of its geographical position as related to the others of the thirteen original States. They seemed, with prophetic vision, to look into the future—to foresee the important place which this Commonwealth was destined to hold in the completed union of States.

From the first Continental Congress, in 1774, to the present time, there is a space of less than a century and a half. Yet, in the history of Pennsylvania, the progress of centuries has been packed into this period. Vast natural riches, that were peculiarly suited to the building of an industrial commonwealth, were here placed in the keeping of a fusion of races such as would naturally make an industrious population. And the result is the Pennsylvania of to-day—the keystone of the nation's industry. In every department of activity the State has broadened with the growth of its population and wealth.

The State of Pennsylvania lies between latitudes 39° 43′ 26.3″ and 42° north and between longitudes 74° 40″ and 80° 31′ 36″ west. It has the form of a parallelogram, except that in the northwest part there is a triangular projection northward, giving a shore line of about forty miles on Lake Erie. Its main northern and southern boundaries are 157.76 miles apart. Its average length is 285.85 miles. Its extreme length, from the Ohio State line to a point below Trenton, is 306 miles. The total area is 45,126 square miles, and of this 294 square miles are water surface, and 44,832 square miles land surface. The mean elevation of the State is 1100 feet above sea level. From an elevation of twenty feet or less on the banks of the Delaware, between Philadelphia and Chester, the country rises to a height of 2000 to 3000 feet on the higher Appalachian ridges in the middle section. On Blue Knob, in Bedford County, a summit of the Alleghenies, it reaches an elevation of 3136 feet. On the Ohio border it falls again to 900 to 1000 feet, and on the Erie plain to 750 feet. The southeastern part of the State has an area of 6100 square miles that has a mean elevation of less than 500



NAVIGATION IN PENNSYLVANIA—PAST, PRESENT, AND PROPOSED

feet above the sea. In the middle of the State there is an area of 2000 square miles that everywhere exceeds 2000 feet in elevation. The Appalachian system, which embraces the eastern mountains of the United States, attains its greatest width within the borders of the State. The great ridges of this system extend slantingly across the State, from the northeast toward the southwest.

The State may be divided into three topographical regions. The first includes all that portion between the tidewater reach of the Delaware River and the Kittatinny Mountain, ascending northwestwardly to an average elevation of about 500 feet in Kittatinny Valley.

The second region is a belt of ridge and hollow averaging 50 miles in width. This starts from the Delaware River, bordering Pike and Wayne counties, and, extending westward and southward, passes into Maryland 240 miles from the point of beginning. This huge welt across the State appears to have been bulged up in the making by pressure from the southeast. This belt has an area of 11,808 square miles.

The last and largest distinct topographical region is the Allegheny Upland. Generally this is a high plain, undulating in wide, low swells, and gently descending southward and southwestward. In the valleys proper of the Ohio and its main Pennsylvania affluents, the relief of the country is very uniform. The area of the Allegheny Upland is 24,861 square miles, or about 55 per cent. of the area of the Commonwealth.

Generally, the northeastern portion of the Allegheny plateau and nearly all of the central and southeastern portions of the State are drained by the Susquehanna and Delaware River systems into the Delaware and Chesapeake Bays. The greater part of the Allegheny plateau is drained by the Allegheny and Monongahela Rivers into the Ohio River. The southern portions of the central part of the State are drained by tributaries of the Potomac. The Erie plain is drained by short streams into Lake Erie, and a small section of the Allegheny plateau, in the northern part of Potter County, is drained by the Genesee River into Lake Ontario. The Susquehanna drains about 21,000 square miles of the State; the Ohio, Allegheny, and Monongahela, 14,747, and the Delaware, 6443.

The history of the settlement of Pennsylvania dates back to 1623. Between that year and 1681 trading posts were established by the Swedes and the Dutch along the lower valley of the Delaware River. As early as 1660 George Fox and a few other prominent Quakers began to urge the establishment of a colony to serve as a refuge for

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THE "PACKSADDLE," JUNIATA RIVER PENNSYLVANIA RAILROAD

Quakers. At least as early as 1666, William Penn became interested in the plan, and in 1680 he was granted, in repayment of a claim on the Crown for £16,000, "a tract of land in America, bounded on the east by the Delaware, on the west limited as Maryland, northward as far as plantable."

There has been a popular belief that Pennsylvania was named in honor of its founder, but, in fact, "by the King's order, much against Penn's inclination, the new province was to be called Pennsylvania, in honor of the services of his illustrious father."

By the charter of Pennsylvania, Penn was made proprietary of the province. During Penn's life the colony was involved in serious boundary disputes, and it was not until 1784 that Virginia agreed to the establishment of the western limit as it now is. The small triangular strip which gives the State access to Lake Erie was sold to Pennsylvania by the Federal Government in 1792.

The scope of Penn's early plans is indicated by the fact that he purposed to make a second settlement far to the westward of Philadelphia. This was to have been on the Susquehanna, and as early as 1687 a "way" had been "laid out" from Philadelphia westward to the proposed location. The plan of a second Philadelphia, however, was not to be carried out by the founder.

In every great crisis of national history Pennsylvania has borne an important part. The State contributed greatly to the success of the War for Independence by the important services rendered by its statesmen, notably the great philosopher-statesman, Benjamin Franklin. One of her citizens, Robert Morris, was the financier of the Revolution. The two Continental Congresses, that of 1774 and that of 1775-1781, met in Philadelphia, except for the months when the city was occupied by the British army. During that period the Continental Congress met first in Lancaster, then in York, and then in Princeton, N. J. The Declaration of Independence was signed in Philadelphia, and was, from the day of its signing, supported by Pennsylvania. Philadelphia was the seat of the Federal Government, except for a brief period, until the removal to Washington, in 1800. The winter of suffering passed at Valley Forge by Washington's army was the turning point of the Revolution.

During the Civil War, the State gave to the Union 336,000 soldiers; and one of the decisive battles of the war was fought within her borders, at Gettysburg, where Lee's invasion was checked and turned. The Union

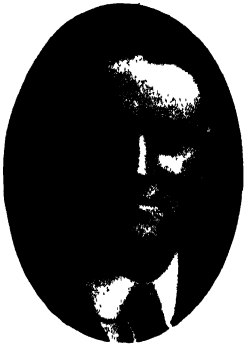
Army, at this battle, was commanded by a Pennsylvanian, Maj. Gen. George G. Meade.

Pennsylvania now ranks second in population among the States, having 7,665,111 people within its borders. Of this number, 3,653,371, or 47.8 per cent., are urban population, and 4,011,740, or 52.2 per cent., are rural population. Owing to its central position, its liberal government, and its policy of religious toleration, Pennsylvania attracted, in the earlier period, many of the best races of western Europe—English, Germans, Dutch, Swedes, Welsh, Irish, and Scotch-Irish. These have now merged into one general type.

With access to the Great Lakes and the Ohio, and thus with the Mississippi, at the west, and to the Atlantic at the east, Pennsylvania has been favorably located for the rapid development of its vast natural wealth. From the beginning of its era of prosperity, its people were keenly alive to the importance of these waterways in the scheme of development. Its early canal chain was a marvel of the period in which it flourished. The State has steadily insisted upon the adequate improvement of its great artery to the sea, the Delaware River. Important waterway improvements are to-day in contemplation, and others in progress, at both ends of the State.

The interest that is now manifested throughout Pennsylvania in the development of waterways makes it peculiarly appropriate that the most notable gathering of navigation experts in the history of the United States should be held in Philadelphia.

NATURAL RESOURCES OF PENNSYLVANIA



JOHN K TENER
Governor of Pennsylvania
Hon Vice-President of The Congress

WM HOWARD TAFT
President of the United States
Honorary President of The Congress

RUDOLPH BLANKENBURG
Mayor of Philadelphia
Hon Vice-Pres of The Congress

J HAMPTON MOORE
President of the Local Organizing
Commission

J S W. HOLTON
Chairman of the Executive
Committee

W T TILDEN
Vice-Pres of the Local Organizing
Commission

Bituminous Coal Production

RANKING first among the natural resources of Pennsylvania are the deposits of coal, which have been so important a factor in the development of its industries. While the export of coal, both bituminous and anthracite, beyond the borders of the State has been an important element in the growth of material prosperity, the main value of these extensive deposits has been their power to attract and create manufactures. The coal of Pennsylvania has drawn within the borders of the State many important industries which in magnitude exceed those of any other State in the Union. Behind the making of a vast array of the more delicate lines of merchandise, behind the building of products of steel, is the coal that underlies the hills of the State.

The anthracite deposits of Pennsylvania are located in the northeastern part of the State, in the counties of Susquehanna, Lackawanna, Luzerne, Carbon, Schuylkill, Columbia, Sullivan, Northumberland, Wayne, and Dauphin, while the bituminous regions are in the central and western portions of the State, their importance in production increasing from east to west. The Broad Top region, in Huntingdon, Bedford, and Fulton counties, stands between the anthracite coal fields of the northeast and the bituminous coal region of the southwest, its coal possessing some of the qualities of the other two.

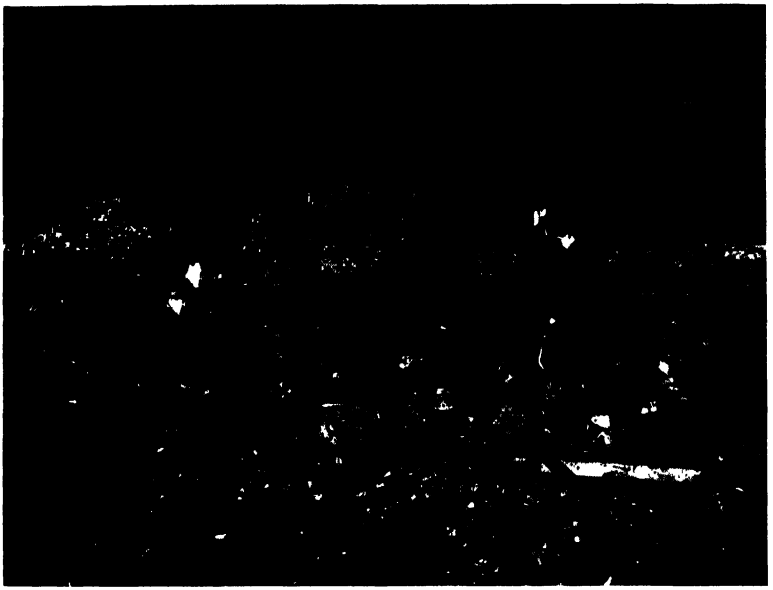
Not only has Pennsylvania virtually all of the anthracite of the country, but it has also the thickest bituminous coal measures. These form the northern extremity of the Appalachian coal field, and the entire district covers an area of 15,000 square miles.

Anthracite coal was discovered as early as 1762, near what is now the city of Wilkes-Barre. Bituminous coal was first shipped from Pittsburgh in 1803, and it was not until the year 1840 that the mining of bituminous coal in Pennsylvania assumed sufficient importance to give it a place in the census reports. In that year the production was shown to be 464,826 tons.

Of the 67 counties in Pennsylvania, 25 produce bituminous coal. A comparison of the figures of the leading States gives an idea of the extent of the industry in Pennsylvania. The production for the United States

in 1908 was 415,842,698 tons, and of this amount the Pennsylvania production was 114,937,375 tons, or more than one-quarter of the total. The production in the State in 1910 had risen to 148,770,858 tons. This was approximately the same as the production of 1907, which year closed a period of marked industrial expansion throughout the country.

In 1908 the mines of Pennsylvania produced more coal than the

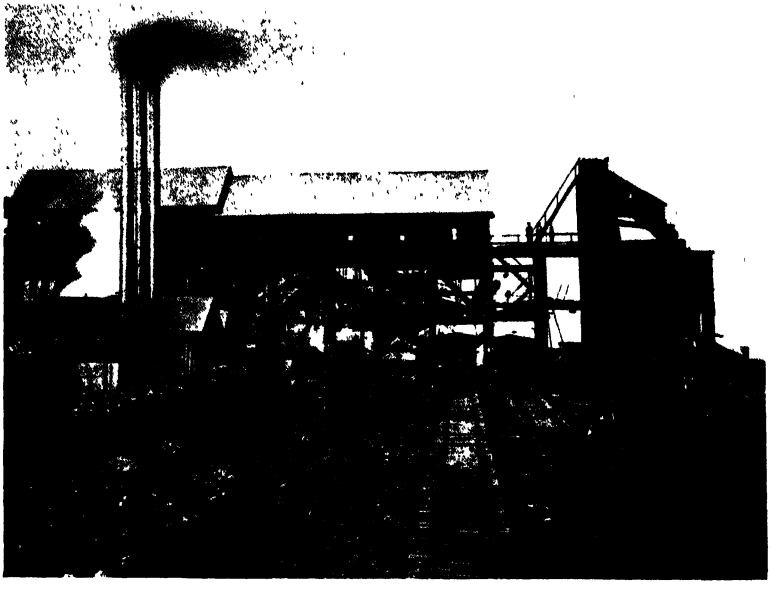


BITUMINOUS COAL MINERS AT WORK IN ONE OF THE MINES OF THE PITTSBURGH-BUFFALO COMPANY, SHOWING ACTUAL WORKING CONDITIONS AT THE FACE OF THE COAL. THIS "ROOM" HAS JUST BEEN UNDERCUT AND SHOT DOWN, AND THE MEN ARE READY TO LOAD THE COAL INTO THE MINE CARS

combined production of all the countries of the world except Great Britain, Germany, and Austria-Hungary. It was in that year five times the production of France and seven times the production of Russia.

Owing, largely, to the suitability of the coal mined in Westmoreland and Fayette Counties for conversion into Connellsville coke, these two are the largest bituminous coal-producing counties of the State. Fayette, which leads the list of counties, produces 31,487,141 tons. Following Westmoreland in the list is Allegheny County, which, besides developing the greatest volume in steel tonnage of any of the world's centers, ranks also among the most important bituminous producing districts.

It is largely due to the coking value of these coals that Pennsylvania has attracted its chain of steel industries, that stretches from the Delaware, on the east, to the Ohio line, on the west. The Connellsville coke-producing district lies in Westmoreland and Fayette counties. The lower Connellsville district is south of the Connellsville district, in Fayette County. The production of coke in this district dates back to 1841.



SORTING AND SHIPMENT OF BITUMINOUS COAL, WESTERN PENNSYLVANIA

Out of a total of 2,752,475 tons of coke made in the United States in 1880, Pennsylvania produced 2,317,149 tons, which was made from 3,608,095 tons of coal. In 1905 the total production in Pennsylvania was 20,573,736 tons, while the total production in the country was 32,231,129 tons. The 1907 production for the entire country was 40,779,564 tons. Of this, the Pennsylvania production was 65 per cent., or 26,513,214 tons. The 1910 production of coke in Pennsylvania was 23,722,944 tons.

The following table shows the number of tons of coal and coke shipped from the mines of the various districts, the total number of tons mined and the number of employees in these districts in 1910:

owing to the extent of the coal-bearing area and the relatively small cost of opening new mines, that it has heretofore seemed an impossibility. However, if the opening of new mines can be minimized, and a check placed upon the ambition of some of the producers to make a new tonnage record each year, two causes that operate against the success of the trade would be eliminated. The present productive capacity of

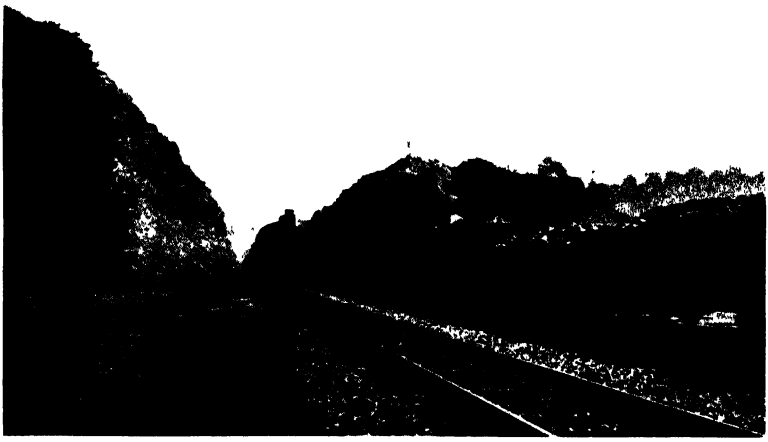
ENTRANCE TO A BITUMINOUS COAL MINE

the mines is far beyond the consumption, probably twice as great, and hence the opening of so great a number of new mines and excessive production are deprecated.

It is a fact beyond dispute that there is a tremendous waste of investment in coal-mining property, and that the business will never be as profitable or safe as it should be until some way is found to curtail the production. The rapid growth of the industry has prevented systematic development, and to-day the operators constitute a great army of antagonistic elements. Some writers on the subject have suggested that a national organization of operators be created, the primary object of which would be to prevent the indiscriminate coal land development. It seems to be the opinion of the advocates of this plan that Pennsylvania should take the lead in the movement, for the reason that western Penn-

sylvania produces more high-grade coal than any other region in the United States, and that, on account of its manufacturing interests, it should safeguard its coal supply. Unless this is done, and the wasteful methods discontinued, it is feared by many that ultimately the effect may be disastrous to the commercial life of western Pennsylvania.

Another unfavorable feature of the industry that engages public



COAL TRAINS, PENNSYLVANIA RAILROAD, SHOWING OLD WOODEN CARS OF 25 TONS' CAPACITY AND NEW STEEL CARS OF 50 TONS' CAPACITY

attention and creates criticism is the high record of fatalities that occur among the mine-workers. Those unacquainted with the facts cannot realize the conditions that exist at the present time, due chiefly to the phenomenal growth of the industry. With this vast production, and in view of the rapid methods of extracting the coal, and the fact that many of the workmen are ignorant of the rules of safety, the hazard to life is extremely great.

To meet this peril to life, a thorough system of first-aid work has been instituted, and is being broadened each year. The first organization of the kind in Pennsylvania, and probably in the United States, was the corps organized at the Jermyn colliery of the Delaware and Hudson Company, in 1899, by Dr. M. J. Shields, a practicing physician and surgeon in the anthracite region. Since that time the work has been extended, until to-day at almost every colliery will be found a well organized first-aid corps, ready to render assistance to the injured.

First-aid work in the mines comes under two heads: First, the providing of proper material for first-aid dressing, and second, seeing to it that wherever a considerable number of men are employed there shall be some person who is thoroughly instructed in first aid.

All the mines controlled by larger companies provide some form of first-aid packet. When a man is injured, either the dressing box is brought at once to him, and his wounds are dressed, or he is taken to the surgical dressing room, which every mine has underground. At the surgical dressing room more attention is given, if necessary, than is possible in the mine, and the injured man is then prepared for transportation to his home or to a hospital. A feature of this work is the annual prize contest, held by the different companies, and participated in by the various corps.

Systematic investigation is now going forward to determine the cause of, and find a means of prevention for, the mine disasters which in 1910 resulted in the loss of life of 484 operatives. That the recent efforts along this line have been productive of excellent results is shown by the fact that the number of lives lost inside the mines has steadily decreased since 1907, which was the high-water mark, and in which year the fatalities inside the mines numbered 766. In 1907 one life was lost inside the mines for every 195,247 tons. In 1908 the loss was one life for every 208,977 tons. In 1909 the loss was one life for every 286,749 tons. In 1910 a decided improvement was recorded in these inside fatalities, when the figures showed a loss of one life for every 307,378 tons.

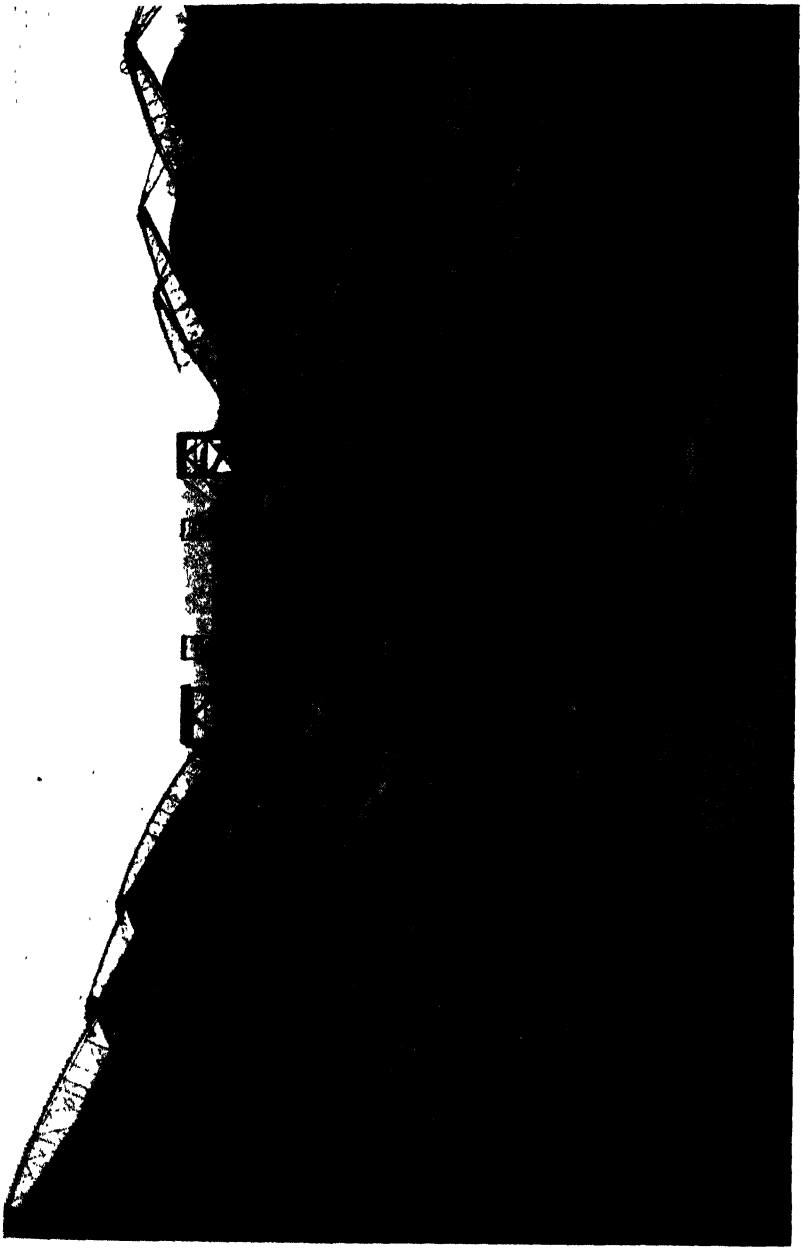
The Anthracite Field

AS LATE as 1812 a presumably well-informed State senator from Orwigsburg declared that while there was plenty of "black stone up Schuylkill, it would not burn." Little was it dreamed, even a century ago, of the vast wealth of fuel that underlay the hills of northeastern Pennsylvania. It was not until long after that year that the extent of the anthracite fields—virtually the only ones in the United States—and their value to the people of the State were fully realized. In the year 1910 there was mined from the hills of this region a total of 74,717,852 tons.

The history and development of anthracite coal in Pennsylvania reads like a romance. Early books on the coal-mining industry of Pennsylvania contain a picture that is supposed to represent the discovery of anthracite coal—a woodsman in coonskin cap, rifle in hand, halting in awestruck wonder before a little heap of "black diamonds." But if the hunter ever existed he doubtless thought of that coal as being "black rock that wouldn't burn."

The anthracite industry was a matter of slow development. Repeated attempts were made with little success to burn "stone coal," even under steam boilers and in furnaces built to burn bituminous coal, before its value as a fuel became known. As late as 1825 the Lehigh Coal and Navigation Company found it advisable to issue a pamphlet in which certificates were given regarding anthracite "from various manufacturers and others proving its decided superiority over every other kind of fuel." One of these testimonials, signed by a well-known Philadelphian of that day, states that he had "used Lehigh coal in my study, and found so many advantages of it that I would not exchange it for hickory wood, even if I could procure the latter gratis." With wood, he said, his feet were almost always cold at night, and "since I have used this coal those grievances are entirely removed." Further, he wrote, "I have no need of chimney sweeps."

It is believed that anthracite coal was discovered in the Wyoming Valley as early as 1762, and the first practical use is believed to have been made of it in 1768 by two Connecticut blacksmiths, named Gore,



BRIDGEPORT TRANSFER, PHILADELPHIA AND READING RAILWAY, NEAR PHILADELPHIA. CAPACITY, 500,000 TONS ANTHRACITE COAL, STORED IN RESERVE

who had settled in the valley. There has been, however, some doubt as to priority of discovery and development in the several anthracite regions.

The discovery of anthracite in the Lehigh region is generally conceded to have been made by Philip Ginter in 1791, at Mauch Chunk. It is said that Ginter had heard of "stone-coal over in Wyoming," and had frequently pried into the rocks in the hope of finding it. Coming across

ANTHRACITE COLLIERY AND BREAKER, MAHANOY CITY, PA.

a tree that had been blown down, he discovered "black dirt and a great many pieces of stone-coal under the roots." It is said that he took these to Col. Jacob Weiss, at Fort Allen, who had them examined in Philadelphia, when they were pronounced to be coal. In the year following, Col. Weiss, Charles Cist, and Michael Hillegas purchased 6000 acres of land in this district.

In the following year a company was formed under the title of the Lehigh Coal Mine Company, which purchased from Jacob Weiss the tract of land on which the large opening at Summit Hill was made, and afterward "took up," under warrants from the Commonwealth, about ten thousand acres of land, embracing about five-sixths of the coal lands now owned by the Lehigh Coal and Navigation Company. The coal mine

company proceeded to open mines, and made an appropriation of ten pounds to construct a road from the mines to the landings, a distance of nine miles. After many fruitless attempts to get coal to market over this rough road, and by the Lehigh River, which, in seasons of low water, in its unimproved state, defied the floating of a canoe over its rocky bed, and after calling for contributions of money from the stockholders until calling was useless, the Lehigh Coal Mine Company became tired of the experiment, and suffered their property to lie idle for some years.

Early works on anthracite state that there is a tradition that coal was discovered in the Schuylkill region about 1790; but there is no authentic mention of the use of coal in the region until 1795, when a blacksmith named Whetstone used it in his smithy. His success induced several others to dig for coal, but after trying to burn it they gave up the effort in disgust. It is probable that the early failures to obtain good results with anthracite coal as a fuel were largely owing to ignorance of the difference between coal and slate. About the year 1800 a William Morris, owner of a tract near Port Carbon, took a wagon load of coal to Philadelphia, but his lack of success in finding a market was as great as that of the Lehigh pioneers. He therefore retired from the business. The coal trade of the Schuylkill region may be dated back to 1806. However, as late as 1812 an effort to interest Philadelphia as a market proved discouraging, and the operator who took to market nine wagon loads was denounced as a knave for his attempt to impose "rocks" on the public for coal. He did, however, finally manage to sell his coal, some of it to White & Hazard, who were then manufacturing wire at the Falls of the Schuylkill. This proved to be a history-making sale.

In the winter of 1812-13 Mr. White, believing that there were valuable coal deposits up the Schuylkill, petitioned the Legislature for authority to improve the Schuylkill River by slack-water navigation, and from this year may be dated his interest in coal lands, which did so much for the development in its early stages. The high rate of freight on the Schuylkill subsequently discouraged Mr. White, and led to the abandonment of his purpose to use the Schuylkill navigation, and he subsequently turned his attention to the Lehigh district.

In December, 1813, the Lehigh company made a lease for ten years of their lands to Messrs. Miner, Cist & Robinson, with the right of cutting lumber on the lands for building boats. The whole consideration for this lease was to be the annual introduction into market of 10,000 bushels of coal for the benefit of the lessees. Five "ark" loads of coal

were dispatched by these gentlemen from the landing at Mauch Chunk, two of which reached Philadelphia, the others having been wrecked on their passage. Four dollars per ton were paid to a contractor for the hauling of this coal from the mines to the landing over the nine-mile strip of road, and the contractor lost money. The principal part of the coal which arrived at Philadelphia was purchased at $21 per ton, by

A "TIMBER SQUEEZE" IN A COAL MINE

White & Hazard. But even this price did not remunerate the owners for their losses and expenses in getting the coal to market, and they were consequently compelled to abandon the prosecution of the business, and, of course, did not comply with the terms of the lease.

In 1820 the navigation of the Lehigh was so far improved that "arks" —rough timber boats—were floated to Philadelphia, carrying 365 tons of coal, which sold at $8.20 per ton. From this time onward Lehigh trade steadily advanced. Two years later, in 1822, 1480 tons of Schuylkill coal passed down the Schuylkill navigation, but it was not until three years later that the waterway was in such condition as to make real development possible. In the meantime the Lehigh product, mainly through the efforts of White & Hazard, was becoming well intrenched in the market. In

both districts the beginning of the era of real development may be traced back to 1825.

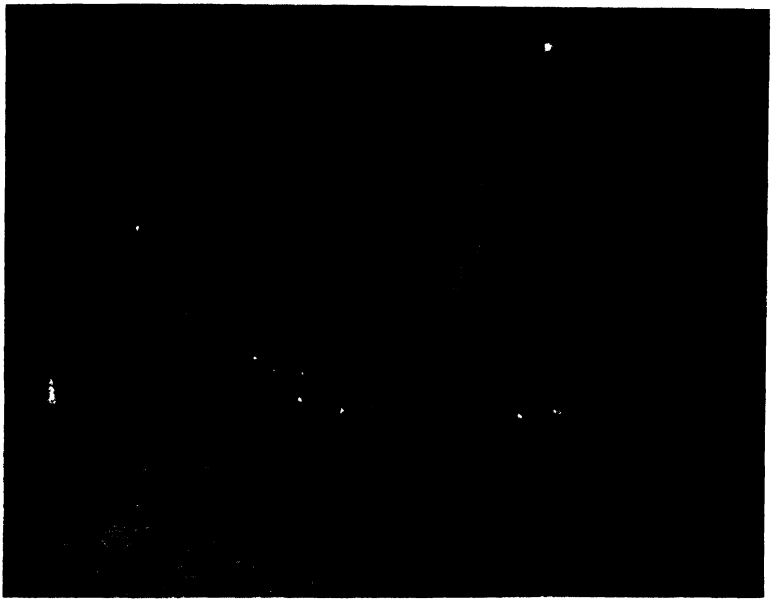
The anthracite district of to-day occupies an area of 480 square miles. It may be roughly outlined by a line drawn from the southeastern point of Susquehanna County, through Luzerne and Lackawanna Counties, to the limit of the Wyoming basin at Shickshinny, thence south through Columbia County to Centralia, thence west and south around the off-shoots of the Schuylkill and Pottsville basins, passing through Northumberland, Dauphin, and Lebanon, thence northeast through Carbon and Schuylkill to Mauch Chunk, and north to the point of beginning. These lines enclose an area of 1700 square miles, only about one-quarter of which, however, actually contains anthracite coal. The highest elevation of this district is 1750 feet above sea level, near Hazleton.

The production of anthracite in this district in 1910 was 74,717,852 tons. The following table shows the production by districts, as officially numbered by the State:

District	County	Average Number of Days Worked in Breaker	Production	Average Production Per Day
First	Lackawanna, Susquehanna, Wayne	186	3,633,389	17,911
Second	Lackawanna	204	4,542,844	21,586
Third	Lackawanna	198	4,469,969	20,771
Fourth	Lackawanna	198	3,963,568	16,853
Fifth	Lackawanna, Luzerne, Sullivan	195	4,045,862	18,848
Sixth	Luzerne	206	4,632,681	21,140
Seventh	Luzerne	166	5 207,392	27,347
Eighth	Luzerne, Lackawanna	187	3,749,647	19,382
Ninth	Luzerne	213	5,621,081	23,598
Tenth	Luzerne	223	4,101,524	18,392
Eleventh	Carbon, Luzerne	226	4,906,012	20,921
Twelfth	Schuylkill	230	2,900,088	12,609
Thirteenth	Schuylkill	224	2,936,654	11,793
Fourteenth	Columbia, Schuylkill	195	2,113,188	10,837
Fifteenth	Northumberland	221	3,038,205	13,748
Sixteenth	Northumberland	231	2,608,507	10,858
Seventeenth	Carbon, Schuylkill	259	4,339,964	15,552
Eighteenth	Schuylkill	229	2,693,900	11,764
Nineteenth	Schuylkill	246	2,930,754	11,495
Twentieth	Dauphin, Schuylkill	207	2,282,623	9,178
Total		212	74,717,852	334,583

Various estimates have been made as to the length of time that will be required to exhaust the supply of anthracite at the present rate of consumption. It is probable that unless the amount taken out annually is largely increased there will be anthracite in Pennsylvania at least a century hence.

But the fact that the anthracite is not inexhaustible has already turned the attention of astute managers of these properties to the question of conservation of the supply. And in a consideration of this problem the first thought would naturally be that of ultilization of the great culm banks that have accumulated through the years of mining operations, and that in former years were regarded as being merely the waste of the mines.



ANTHRACITE COAL MINERS AT WORK

But while this culm is not marketable, in that it is not of any of the regular market sizes, either steaming or domestic, it contains almost inestimable latent power. How best to market this power and thus to relieve the drain upon the supply still underground has been a problem of interest not only to the coal managers, but to the people of the Commonwealth, as it has an important bearing on the future public welfare.

In pursuance of a policy directed toward the utilization of the culm banks, the Lehigh Coal and Navigation Company is building at Hauto a power plant which will rank among the largest in the country. Instead of attempting to market the culm in material form, the company will generate electricity and ship it by copper wire to large consuming points within a radius of 150 miles of the mines.

The making of briquettes from culm has also received attention. So long as good coal is plentiful there is not the same incentive for the development of briquetting enterprise as there would be if the underground supply were in immediate danger of exhaustion. Yet the making and selling of briquettes is to-day carried on successfully by several companies in different parts of the State. Anthracite culm is, however, but one of several low-grade fuels that are available for briquetting in Pennsylvania. Among others are slack coal from semi-anthracite, bituminous, and sub-bituminous coal mines, which does not possess fusing or coking qualities, and is therefore not available for the manufacture of coke, and coke breeze, which possesses high fuel efficiency, but which, because of its small size, cannot be used as fuel either for domestic or other use.

Among important recent developments in the anthracite region are the establishment of schools by various mining companies for the improvement of miners; the introduction of the use of electricity in the mines, both as a source of power and for lighting; the broadening of first aid work for injured miners, and the systematic effort to prevent mine fires.

Iron and Other Mine Wealth

SINCE the opening of the great Lake Superior iron ranges there has been a decline in the iron-ore production of Pennsylvania. Prior to 1880 this was the leader among the States in the mining of iron ore, and in that year it produced 1,951,496 tons. This was an increase of more than a million tons over the last year of the preceding decade. But before the close of the eighties the State had fallen to third place in the production of iron ore, and five years later it was in fifth place.

Very soon after the settlement of Pennsylvania, small furnaces and forges were established. There was an abundance of iron ore, while the forests supplied the charcoal needed for fuel. Thomas Rutter, a smith, living near Germantown, established the first ironworks in Pennsylvania.

In 1714 he removed from Germantown to Pottstown, in order to work the iron mines of the Manatawny Creek. Here he was given a grant of 300 acres of land. In these works the iron was made directly from the ore. The early pioneers of the iron industry had even the dangers of Indian attack to encounter, for it is recorded that, in 1728, a forge near the Rutter Works was attacked by Shawnese Indians, who were finally driven away.

The second forge was established in Chester County, as early as 1720, by Samuel Nutt. There is an opinion that iron was probably made at this forge, which was known as the Coventry Forge, in 1718.

James M. Swank, the leading authority on the iron and steel industry in Pennsylvania, gives as the next iron enterprise in the State, the Colebrookdale Furnace, built about 1720, by a company of which Thomas Rutter was the leader. This furnace was on Ironstone Creek, Berks County, eight miles from Pottstown.

The first mention of export pig iron gives the date of the first shipment as November, 1728. In this year and the next 274 tons were shipped. From this period on the number of furnaces and forges in the eastern part of the State multiplied rapidly. In the early forges iron was

made directly from the ore, but after furnaces were built, pig iron was generally used at the forges.

In the middle of the eighteenth century Pennsylvania was ranked as first among the colonies in this industry. By the year 1791 the development had increased until there were 16 furnaces and 37 forges, many of these in the Schuylkill Valley. But even before the Revolution there

EARLY SHIPMENT OF PETROLEUM IN THE PENNSYLVANIA OIL FIELDS. FLOATED DOWN THE SMALLER STREAMS ON FLAT-BOATS AND TRANSFERRED TO STERN-WHEEL STEAMERS AT OIL CITY, PA., FOR DELIVERY TO PITTSBURGH AND OHIO RIVER POINTS. THE OIL IS NOW PUMPED THROUGH UNDERGROUND PIPE-LINES TO TIDEWATER

were flourishing iron enterprises in the territory lying west of the Susquehanna.

Pennsylvania iron bore an important part in the Revolution. Round iron was drawn under the hammer at Martic Forge, Lancaster County, and bored out for musket barrels. This was done at a boring mill located on a very secluded stream, in order to avoid discovery by the British. An armory was in operation at Carlisle, where wrought-iron cannon were made.

The industry slowly moved westward. As early as 1832 there were 8 furnaces, 10 forges, 1 rolling mill, and 1 slitting mill in Huntingdon County, and 16 furnaces and forges in Centre County. In Centre Huntingdon, Blair, and Mifflin Counties, in 1850, there were 48 furnaces 42 forges, and 8 rolling mills. In the early days of the iron industry in the valley of the Juniata the output was largely conveyed by horses to the

PENNSYLVANIA OIL FIELDS. GROUP OF OIL WELLS NEAR TITUSVILLE, PA.

Clarion River, whence it was floated to Pittsburgh in rough boats. The completion of the Pennsylvania Canal, in 1832, and of the Portage Railroad, in 1834, was a vast stimulus to the early enterprise. The industry west of the Alleghenies, now the leading steel producing district in the world, dates back to 1790, when Turnbull & Marmie, of Philadelphia, built a furnace on Jacob's Creek, near its confluence with the Youghiogheny. The military storekeeper at Fort Pitt wrote to General Knox, in 1792: "As there is no 6-pound shot here, I have taken the liberty to engage 400 at Turnbull & Marmie's furnace, which is now in blast." What was probably the first rolling and slitting mill west of the Alleghenies was built in Fayette County by Jeremiah Pears, in 1804. Fayette County had, in 1805, 5 furnaces and 6 forges, and in 1811, 10 furnaces, an

air furnace, 8 forges, 3 rolling and slitting mills, 1 steel furnace, and 5 trip-hammers. In 1816 there was erected on the site of Jeremiah Pears' early forge the first rolling mill in the United States to puddle iron and roll iron bars. Westmoreland County, Somerset County, and the other counties of the western district followed Fayette closely in the development of the enterprise.

A FIELD OF LANCASTER COUNTY TOBACCO

Prior to 1840 no fuel other than charcoal was used successfully in the American iron industry. To-day the charcoal furnaces are virtually wiped out. The iron industry in Pennsylvania steadily expanded down to the fourth quarter of the last century, when the opening of the Superior ranges began. However, in the production of magnetite ore the Lebanon mines still lead the country. To-day, in addition to the ore brought into the State from the West, large quantities are imported from Sweden, Cuba, and other countries. It is owing to this foreign source of iron supply that the steel industries of extreme eastern Pennsylvania have flourished in the last few years, in competition with the interior interests, which draw from the western supply.

The existence of petroleum in Pennsylvania was known as early as

1721. However, it was not until 1859 that the value of the product commercially was understood. In that year an oil well was bored by Edwin L. Drake, at Titusville, from which was pumped 25 barrels a day. From that time the industry advanced with rapid bounds. By the close of 1861 wells had been drilled from which as high as 3000 barrels a day flowed without pumping. The output of the State increased steadily

CUTTING TIMBER FOR CHEMICAL INDUSTRY, NORTHWESTERN PENNSYLVANIA

until 1891, in which year it amounted to 31,424,206 barrels. In that year the wells began to go dry, and by the year 1908 the production had dropped to 9,424,325 barrels.

As petroleum was accidentally discovered in a salt well, so natural gas also was discovered in Pennsylvania by chance in the early operations in the oil fields. In drilling for some of the first wells, gas escaped. It was at first allowed to discharge into the air, but it was soon used as fuel in generating steam for oil-drilling. Here and there wells were drilled for oil, but produced only gas, and it began to be realized that here was an important natural source of wealth. In 1868 experiments were made to determine whether gas could be successfully used as a manufacturing fuel. Four years later natural gas was piped near Titus-

WORKS OF STANDARD CAST IRON PIPE COMPANY, BRISTOL

CORNWALL IRON MINE, NEAR LEBANON, PA.

ville for use both as fuel and light. Between the years 1882 and 1888, the natural gas output increased from $75,000 to $19,282,000. In this latter year the output in Pennsylvania was more than 80 per cent. of that of the entire country, the gas region covering an area of nearly 15,000 square miles. It embraced virtually all of the Allegheny plateau. Following the year 1888 natural gas developments went forward in other sections of the country, but Pennsylvania production still remained in first place.

Salt was one of the important products of the earlier period of Pennsylvania history, having been discovered on the Conemaugh in 1812. There were important salt industries down to 1860, but in 1889 there was but one plant left in the State, and the industry is now virtually extinct.

There is a small production of zinc near Bethlehem, lead and copper have been smelted in small quantities, and a nickel mine has been profitably worked in Lancaster County.

Lumbering and Agriculture

Lumbering is to-day and will continue to be an important industry in Pennsylvania. In place of the wasteful methods that characterized the operations of former years, in this as in other States, there has come an economic treatment of forest wealth, not only to obtain the most from the timber that is cut, but also to conserve the forests for the future. Formerly the trees were not cut close to the ground, but instead five or six feet above the ground. In the mill, thick saws were used, with the result that an important percentage of the log went to sawdust. To-day the trees are felled to the ground as close as possible, and every part that can be used is utilized. Branches and butts of the soft woods and also the small trees are made into soft wood pulp. When the logs reach the mills the same sort of economy is practiced. All the offal is utilized by making it into lath, pickets, and kindling wood. Thin saws are used, with the result that the percentage of sawdust is reduced, and even the sawdust is used as fuel.

The statement of timber cut in 1909 gives an idea of the extent of the lumbering interests. The number of acres cut over was 105,736; the number of feet of white pine cut, board measure, was 51,678,063; hemlock, 415,829,709; other woods, 320,270,726. The number of cords of bark peeled was 250,869; the number of cords used as pulp wood, 169,724; the number of cords used in the manufacture of alcohol or acid, 135,008; the number of cords of cord wood cut, 385,139; the number of feet cut

for mine props, 51,075,135; the number of feet cut for railroad ties, 13,515,543; the number of feet for telegraph poles, 485,450. Large as these figures seem, they show a very important falling off in the lumbering industry. In 1900 the number of feet of hemlock cut was 1,037,805,000. This figure contrasted with the first figures given affords an idea of the contraction of the lumbering industry in Pennsylvania.

In agriculture the State has long held a leading position by reason of its diversity of production. Lancaster County's place in the tobacco-producing districts of the country is well known, but few even of Pennsylvanians realize that in annual value of agricultural production Lancaster County has led all the counties in the United States. In recent years steadily increasing attention has been paid to the subject of diversified farming and crop rotation. It is probable that in no other State has this science been carried so far.

Many parts of the State have soils that are peculiarly suited to the production of particular crops, and the agricultural interests of Pennsylvania as a whole will continue to rank high among those of the States generally. Among cereal crops adapted to the soil and climate are corn, wheat, and oats, in the order named.

Conservation of Forest Wealth

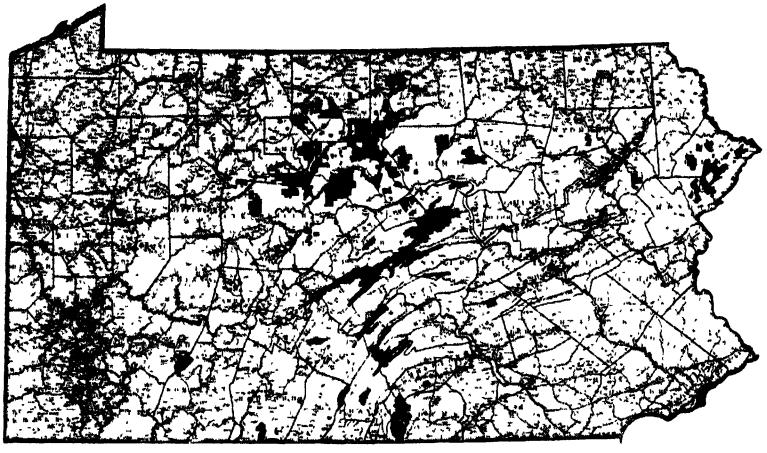
RAPIDLY advancing toward the time when 1,000,000 acres of stripped land will be set aside for forest growth within its borders, Pennsylvania is to-day unquestionably in the lead among the States in the aggressiveness and effectiveness of its reforestation work. Already, tracts to be covered with new-made growths that will be the forests of the future, aggregate more than 900,000 acres, while additions are rapidly being made. What with this work by the State, and the reforestation conducted by the Pennsylvania Railroad; what with the support given by the people of the State; what with the enabling laws—contrasting sharply with the restrictive enactments of nearby States—Pennsylvania will retain that sylvan character which caused its beautiful forests to be first thought of when its name was coined.

The great founder knew naught of the extent of its wealth of ore and coal, of the hidden streams of oil, of the potency in so many directions, that were to make the Pennsylvania of the future. The forests were the visible natural wealth. At the time the colonists settled in Pennsylvania the State was one of the best wooded areas on the Atlantic seaboard, and from the time of Penn the attitude of the Government toward these forests has been that of care and protection. Penn himself incorporated in the Charter of Rights the proposition that for every five acres cleared one acre should be left in trees. As early as 1700, laws were passed by the Proprietary Government relative to the firing of woods, and from that time to this the question of the prevention of forest fires has been given careful consideration.

Many years before the First Conservation Congress, held at the National Capital, when the attention of the States generally was focused, through their governors, on the conservation of forests, Pennsylvania had made notable advance in this line of work. The first activities in the State which led to the advancement of forestry ideas were the lectures given by Dr. J. T. Rothrock, beginning with 1870, after he had been designated as Michaux Lecturer on Forestry, under the legacy left by André Michaux to the American Philosophical Society in Philadelphia.

In 1873, and the following years, Governor Hartranft called the

attention of the Legislature to the immediate needs of the State as regards the care and protection of forests, and in 1877 a State Board of Agriculture was organized, which, at its first meeting, devoted most of its time to forestry questions. From that time the development of forestry has been very rapid, although at the same time the destruction of the forests has gone on at an amazing pace.



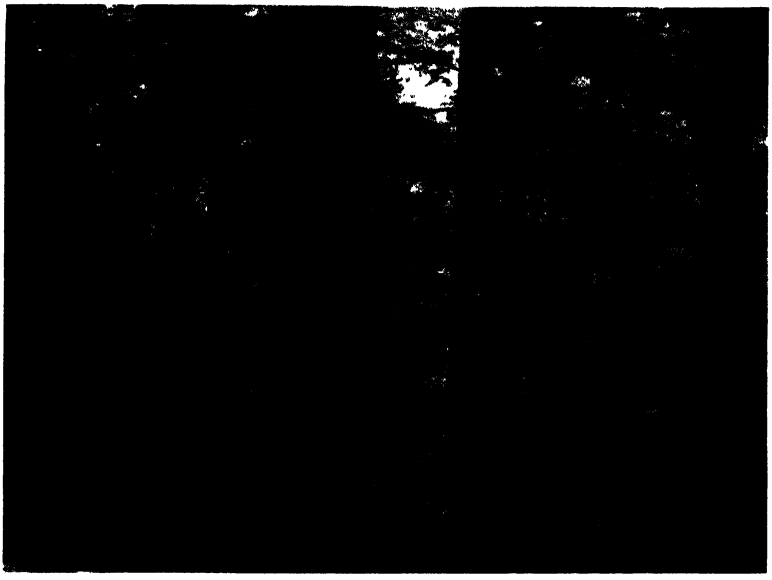
THE FOREST RESERVES OF PENNSYLVANIA

As early as 1901, Doctor Rothrock said, relative to public sentiment on this subject: "If I can read correctly the temper of the public mind, it is largely in favor of the State taking back under its own management a very considerable portion of the mountain land which had been alienated by sale to corporations or individuals. It had become apparent to all thinking persons that there were certain natural laws which must be observed if the prosperity of the State was to be maintained, and that this could only be done by the State recovering possession of the stream heads of the State.

"There is no reason to believe that this view will ever be changed. It appears to be a part of the accepted order of things which has come to stay."

In 1895 it was decided that satisfactory results could not be obtained along forestry lines by private individuals, and that it was necessary for the State to take more active steps in its own behalf. Consequently, a Commissioner of Forestry was appointed as chief of the Division of

Forestry in the Department of Agriculture. In 1901 this division was made a separate department. At the close of the year 1904, which still antedated the adoption of reforestation by many of the States on the present wide basis of policy, Pennsylvania owned forest reserves in 23 counties, amounting to 549,565 acres. In the following two years this was increased to a total area of 701,297 acres.



VIRGIN HEMLOCK FOREST, STATE FORFST RESERVE, SNYDER COUNTY

To-day the department has control of 972,000 acres of State forest reserves, land which has been purchased outright by the State since 1900, at an average cost of $2.25 an acre. In charge of this reserve land there are now 46 foresters. The present Commissioner of Forestry, Robert S. Conklin, is chief of a system of fire wardens which covers the State. The department conducts a school for the training of young men to care for the State lands, giving a three years' course in forestry and allied sciences. It has also established three large nurseries for the raising of forest tree seedlings, which aggregate in area about thirty-seven acres. In addition, there are a number of small nurseries on the various State reserves.

Up to January 1, 1912, approximately 4,000,000 seedlings had been

planted on the state reserves, covering about two thousand acres of what had been cleared or denuded lands. Two million seedlings were planted in 1911 alone. The foresters and rangers in charge of the reserves have reopened and improved 3341 miles of roads, which serve both for transportation purposes and fire lanes in connection with protection from forest fires. The tracts are in the following counties: Adams, Bedford, Cam-

A VIEW IN THE STATE FOREST RESERVE, SHOWING TAKING OF TIMBER

eron, Centre, Clearfield, Clinton, Cumberland, Dauphin, Elk, Franklin, Fulton, Huntingdon, Juniata, Lackawanna, Lycoming, Mifflin, Monroe, Perry, Pike, Potter, Snyder, Somerset, Tioga, Union, Westmoreland, and Wyoming. The laws of the State permit the practicing of forestry in all its phases upon the State land, and, from the sale of dead and defective timber, and revenues from minerals, the total revenue from State reserves, on January 1, 1912, amounted to over $50,000.

The Department of Forestry is in position to be of valuable assistance to individuals in the matter of planting trees and handling woodlots. It is able to supply at cost a number of forest tree seedlings, and at this time has already supplied 161,000. It renders assistance and advice in the matter of planting and of improving woodlots. Inspection is made of the

property, and advice given only after the conditions in connection with the tract have been carefully examined on the ground. This assistance to individuals is rendered free of charge. The State now has an act which protects shade trees generally, and provides for shade tree commissions. There is also an act providing for the establishment of municipal forests by cities of the State; also several minor acts which provide satisfactory protection to trees, as, for example, along roads.

TIMBER LANDS STRIPPED FOR THE CHEMICAL INDUSTRY

Prompt action is taken whenever the forests are in any way threatened. The "chestnut tree blight," which has so endangered the chestnut growth from one end of the State to the other, is now not only engaging the attention of the department, but a commission has been appointed, and an appropriation made for the suppression of the evil. Grave as is this menace to Pennsylvania forests, the present activity makes it plain that whatever may be done to minimize the effects of the blight will be done.

Pennsylvania has the largest and strongest forestry organization in the United States—the Pennsylvania Forestry Association. Arbor Day has been constantly observed in the public schools, and by the people

generally, since 1887. Since that year a constant effort has been made by the State to induce private individuals to practice forestry by allowing a rebate of taxes on forest lands, but in each case the laws have been declared unconstitutional, and the forestry authorities are still trying to have some law passed which will stand the test. The Forestry Association, during the last decade, has continued its activities in the matter of spreading forestry knowledge and keeping up the interest generally in forestry work. The women's clubs and the press of the State have assisted to an important extent in this work. Recently a State branch of the National Conservation Association has been organized, and has begun a work in the matter of spreading forestry information.

As compared with other States, Pennsylvania is undoubtedly in the lead in forestry work. In the number of acres owned, Pennsylvania is exceeded only by the State of New York; but, as Gifford Pinchot, former National Forester, has recently said, "Forestry is thriving everywhere in New York except in the forest." Pennsylvania not only has the public interested in forestry, but is doing practical forestry work on the lands which it owns. The reserves are being used in every possible way for the service of the people. Approximately 10,000 persons were on these lands for hunting and fishing purposes in 1911. There is no record of how many used them for other kinds of recreation.

A number of cities and towns receive a constant and pure supply of water from the protected watersheds within the forest reserves. The timber on these lands which is dead, dying, or defective is being placed upon the market and utilized as rapidly as possible. Whenever minerals of any kind are found, and it is thought wise to have them developed, leases are granted in accordance with law. On the South Mountains a large area has been set aside for the use of a sanatorium for tubercular patients. On a number of reserves large areas are set aside as game refuges.

The Advance of a Giant Industry

HIGH in importance among the elements that go to make up the natural riches of Pennsylvania may be ranked that belt of cement rock in what is known as the Lehigh district, which has made possible one of the most notable of Pennsylvania's industrial developments. The history of this period of development, in which the production of the Lehigh district has gradually expanded until it has now reached the total of more than 26,000,000 barrels a year, may truly be regarded as one of the most absorbing of industrial romances. Over the last twenty-five years of this period the advance in production has been by leaps of millions of barrels annually. Truly, if this is "the cement age," the Lehigh district is one of the great vital factors of the age.

While the virtual monopoly which in 1897 the Lehigh district enjoyed in American cement production has been gradually weakened, it may be said that there has not been, in any year prior to 1911, a check to the growth of the industry in that region. Cement plants have sprung up to dot the country from Atlantic to Pacific. Yet the natural advantage enjoyed by the chain of plants that tap this rich vein of "cement rock" has maintained for the Lehigh district its leading place in American cement production.

A number of limestones, suitable for use as Portland cement materials, occur in Pennsylvania. The Ordovician limestones, which furnish the cement rock of the Lehigh district, occur in varying development in the counties of Northampton, Lehigh, Berks, Lebanon, Dauphin, Cumberland, Franklin, Lancaster, Center, and Blair, and to a much less extent in several other counties of southeastern Pennsylvania. They belong to the Shenandoah group, and throughout eastern Pennsylvania they are underlain by a highly magnesian rock and overlain by a thick series of shale and slate. These limestones are here and there within the allowable limit of magnesia, and are, therefore, in such places an excellent Portland cement material. In places their value is increased by the presence of a high percentage of clayey matter, which renders the material a natural cement rock.

The Lehigh cement belt extends from Siegfried, Pa., to Phillipsburg,

GENERAL VIEW OF PLANT, UNIVERSAL PORTLAND CEMENT COMPANY

N. J. These rocks are laminated water lime rocks, and by reason of their chemical composition, as well as their structural character, are specially adapted to the manufacture of Portland cement.

The first American Portland cement plant was that of the Coplay Cement Company, of which Mr. David O. Saylor, of Allentown, was the president. This plant was established about 1865, and made natural

GATUN LOCK AND GATES, PANAMA CANAL. PITTSBURGH STEEL AND LEHIGH CEMENT

cement of excellent quality. Mr. Saylor, who was a man of indomitable energy and great ability, made up his mind in the early seventies that he could make Portland cement in this country, and his first experiments are most interesting. He knew that by burning to incipient vitrifaction the rocks of his quarry he could make a cement that after short periods showed tensile strains equal to the imported Portland, but he found this cement would crumble away as time went on, owing to the variation in the raw material. Mr. Saylor studied out and successfully applied to the Lehigh rocks the principle which to-day governs the production of Portland cement.

The various layers in the natural rock vary in size and stratification,

so that the lime, alumina, and silica may not be in position to combine under heat, or there may be too much of one ingredient, or not enough of the others in close proximity to each other. In making Portland cement these rocks, properly proportioned, are accordingly broken down and the laminæ distributed in many small grains. This powder is then mixed with water, and is made into a new stone in the shape of a brick,

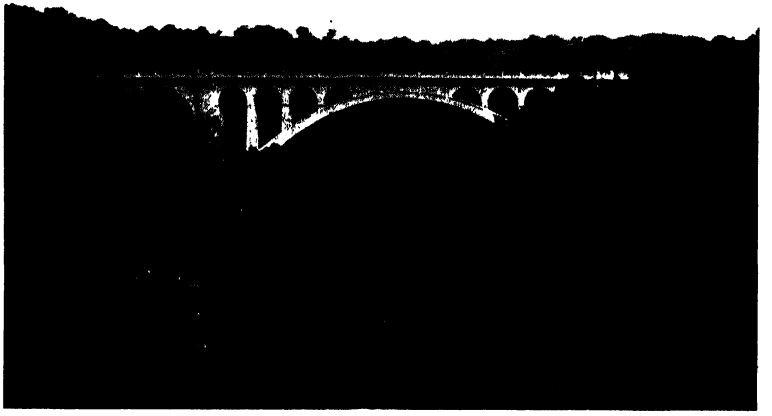
ROTARY CEMENT KILNS

or block, in which all the small grains formerly composing the laminæ of the original rock are distributed and brought into a close mechanical juxtaposition to each other. The new rock thus made is put into kilns with layers of coke, and is then calcined at temperatures from 1600° to 1800° F. The clinker, as it comes from the kiln, is then crushed and ground to an impalpable powder, which is the Portland cement of commerce. Portland cement may be made from other materials, such as chalk and clay, limestone and clay, cement rock and limestone, and marls and clays. In every case the principle is the same, the breaking down and the redistributing of the materials so that the fine particles may be in close mechanical union when subjected to the heat of the kiln.

It was this principle which Mr. Saylor worked out in his experiments

which founded the cement industry in the Lehigh region. From this beginning the industry spread rapidly until a chain of plants tapped the cement ledge from end to end.

The early manufacturer in the United States had difficulty enough in persuading architects and engineers to use this material at all, and it was only upon the statement that, in chemical constitution, its ingredients



CONCRETE ARCH BRIDGE SPANNING THE VALLEY OF THE WISSAHICKON AT WALNUT LANE, PHILADELPHIA

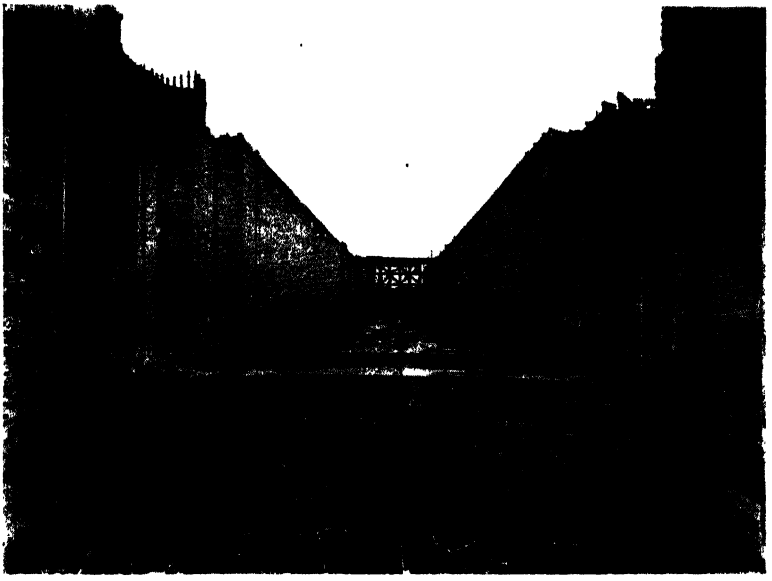
were similar to those of the well-known Portland cements of Europe, and that it was made by similar processes, that he was able to get a hearing, though he was still handicapped by the fact that the material was made from new ingredients, and also by new processes.

American Portland cement, even as late as the nineties, had to show its right to exist as an engineering material, and its right to be trusted with the duty of carrying the strains which are now expected of it. The well-known and successfully made brands of England and Germany had carried the burdens imposed, and had carried them well, and the market was at their command.

The greatest period of the development of the industry followed the introduction of the rotary kiln. Originally, rotary kilns of 40 feet in

length were considered large, but experimenters, among them Thomas A. Edison, soon increased this length to 150 feet.

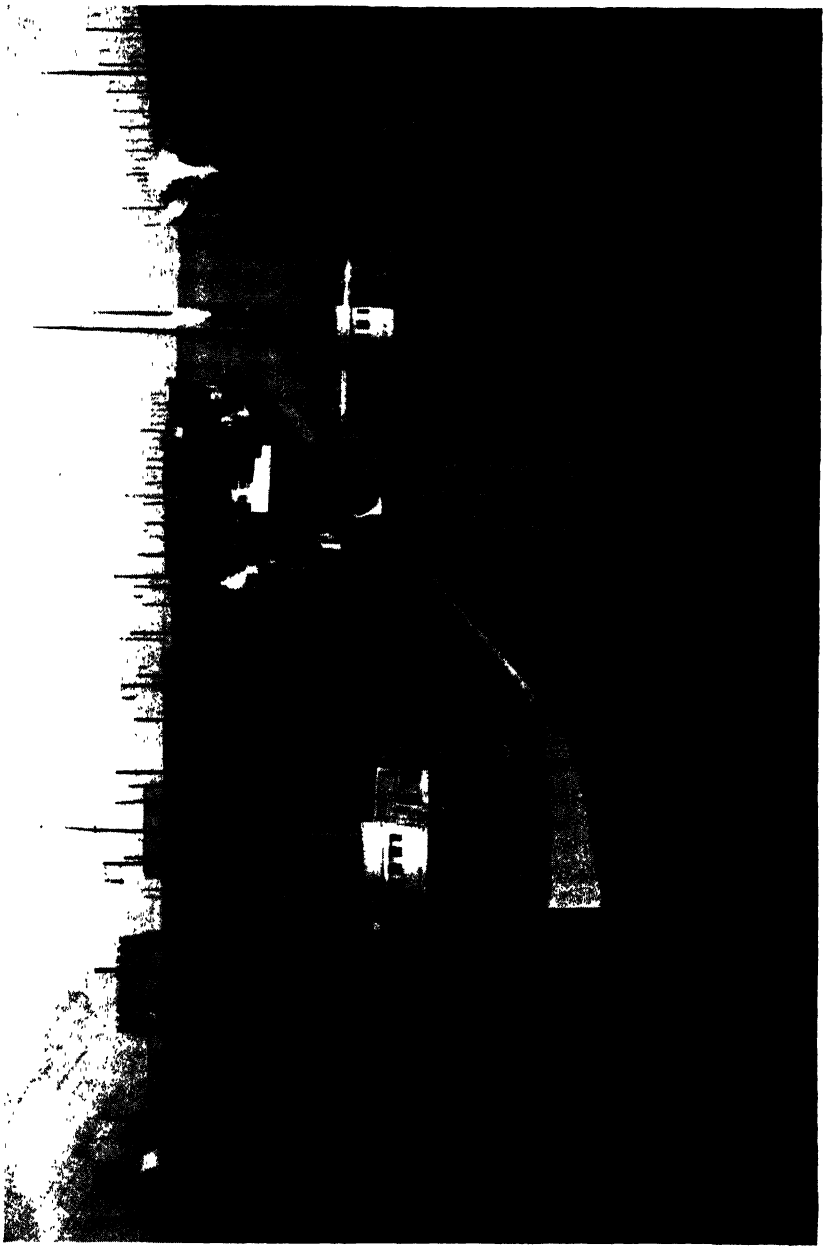
In the process of cement-making, the material is fed into the upper end of the kiln from tanks. The kiln revolves at the rate of from one-half to one revolution per minute, and is inclined from the stack, where the material is fed in, to the discharge end. The mix gradually works



GATUN UPPER LOCK, PANAMA CANAL. BUILT OF PENNSYLVANIA CEMENT

its way down to a point near the discharge end. At this point, which varies according to the materials used, and the length of the kiln, in what is called the fire zone, the calcining of the material takes place. The material at the upper part of the kiln gives up its carbonic acid gas and moisture under the flame directed upon it from the lower end.

This lower end of the kiln projects into a stationary or movable hood, which forms a shield to protect the burner and regulate the admission of air. In this hood are nozzles, which supply the requisite fuel. The mechanism for feeding the powdered coal varies in different mills. In practically every case, however, there are nozzles, through which the pulverized fuel is driven by blast, at either high or low pressure, regulated by the burner. The stream of powdered coal from the nozzles



LAKE STEAMERS LOADING IRON ORE, MESABA DOCKS, DULUTH, MINN.

carries with it a certain quantity of air, from around the hood or from other openings, and this supports combustion. As the pulverized fuel strikes the heated kiln and is transformed into gas, a series of explosions takes place. The flame goes through the kiln, drives out the carbonic acid gas and moisture from the material at the far end, and burns the material in the fire zone to incipient vitrifaction. After calcination, the material goes to the discharge end, where it falls into elevators or conveyors, by which it is carried to cooling towers, which are large iron cylinders subjected to forced draft, and in which the material as it falls is fully exposed to the cool air. It then goes to the grinding mill, where it is ground to almost impalpable fineness.

Up to the year 1896 the development of the industry in the Lehigh region was slow. In that year it exceeded 1,000,000 barrels for the first time. In the ensuing 14 years it advanced to 26,284,411 barrels. The following table shows the advance in production, and shows also how, as the industry has grown in other parts of the country, the Lehigh percentage of the entire production has decreased:

PORTLAND-CEMENT PRODUCTION IN THE LEHIGH DISTRICT AND IN THE UNITED STATES, 1890-1910, IN BARRELS

Year	Lehigh District	Entire U. S.	Percentage Lehigh District
1890	201,000	335,500	60 0
1891	248,500	454,813	54.7
1892	280.840	547,440	51.3
1893	265,317	590,652	44.9
1894	485,329	798,757	60.8
1895	634,276	990,324	64.0
1896	1,048,154	1,543,023	68.1
1897	2.002,059	2,677,775	74.8
1898	2,674,304	3,692,284	72.4
1899	4,110,132	5,652,266	72.7
1900	6 153,629	8,482.020	72.6
1901	8,595,340	12,711,225	67.7
1902	10,829,922	17,230,644	62.8
1903	12,324,922	22.342,973	55.2
1904	14,211,039	26,505,881	53 7
1905	17,368,687	35,246,812	49.3
1906	22,784,613	46,463,424	49.0
1907	24.417,686	48,785,390	50.0
1908	20,200.387	51.072,612	39.6
1909	24,246,706	64,991,431	37.3
1910	26,284,411	76,549,951	34.3

The estimated figures for 1911 show a slight falling off from 1910. The production is estimated at 25,924,516 barrels, and the total shipments from the region, 25,634,671 barrels. However, in western Penn-

sylvania, where the enormous plant of the Universal Portland Cement Company is located, there was an increase in production from 6,072,987 to 6,675,294 barrels, and an increase in shipments from 5,615,662 to 6,553,895 barrels. Pennsylvania, therefore, held its dominating position in the cement industry.

Twenty-five plants produced Portland cement in Pennsylvania in 1910. Of these, 20 plants were located in the Lehigh district as follows:

Blanc Stainless Cement Company, Allentown.
Bath Portland Cement Company, Bath.
Pennsylvania Cement Company, Bath.
Atlas Portland Cement Company, Northampton and Coplay.
Coplay Cement Manufacturing Company, Coplay.
Central Cement Company, Egypt.
Reliance Cement Company, Lesley.
American Cement Company of Pennsylvania, Egypt.
Alpha Portland Cement Company, Martins Creek.
Dexter Portland Cement Company, Nazareth.
Nazareth Cement Company, Nazareth.
Phoenix Portland Cement Company, Nazareth.
Lehigh Portland Cement Company, Ormrod, West Coplay, and Fogelsville.
Penn-Allen Cement Company, Penn-Allen, near Nazareth.
Lawrence Portland Cement Company, Siegfried.
Allentown Portland Cement Company, Evansville.
Northampton Portland Cement Company, Stockertown.

All of these plants use limestone and "cement rock" or "cement rock" alone, except the Blanc Stainless Cement Company, which uses limestone and clay and produces a white Portland cement. Aside from these plants there are five Pennsylvania plants not in the Lehigh district, as follows: The Universal Portland Cement Company, at Universal, near Pittsburgh, which uses blast furnace slag and limestone; the New Castle Portland Cement Company, and the Lehigh Portland Cement Company (formerly the Shenango Company), at New Castle, utilizing limestone and shale; the Crescent Portland Cement Company, at Wampum, also using limestone and shale; and the Sandusky Portland Cement Company, at York, which manufactures a white Portland cement from limestone and clay. Nearly all these plants use coal for fuel. In two cases oil

is reported as used for fuel, and in one case both oil and coal are the fuel.

An idea of the magnitude of these plants is given by the fact that when the Isthmian Canal Commission wanted 4,500,000 barrels of cement for use in the construction of locks and the Gatun Dam, on the Panama Canal, a single company could, and did, contract to deliver the entire amount when and as needed.

REFORESTATION OF PENNSYLVANIA. CULTIVATION OF WHITE PINE SEEDLINGS

Perhaps no chapter in cement history is more amazing than that which tells of the advance of the product into new fields—the creation of new uses. Cement is found to-day in scores of places where a decade ago it would not be dreamed of. From the elemental uses, cement quickly advanced to the stage where it is in use in practically every type of structural work. Its fire-proofing value was one of the many reasons for this expansion. Factories, dwellings, churches, schools, office buildings, prisons, lighthouses, warehouses, farm buildings, piers, bridges, viaducts, chimneys, dams, retaining walls—all these constructions and more—have come within the advancing path of cement. And this ever-broadening path now includes telegraph poles, fence posts,

household utensils, stoves, safes, vaults, bee-hives, hen's nests, wine vats, pergolas, arbors, statuary, building ornaments, tombstones, and burial vaults.

One of the interesting recent developments that have shown new possibilities for cement is the invention of what is known as the cement gun. In this machine, streams of sand, cement, and water are forced

CONCRETE "BLEACHERS" AT ATHLETIC BASEBALL PARK DURING A WORLD'S CHAMPIONSHIP GAME

through separate tubes to a common nozzle, from which they issue in a mixed stream. This has simplified stucco work, and has made possible many new processes in structural work. This gun has also been used to protect the slopes of the Culebra Cut of the Panama Canal.

As Pennsylvania enterprise led in the creation of the cement industry in this country, and in the perfecting of the process of manufacture, so it has led in the extension of the uses for cement.

Export of cement into other countries is steadily increasing, while imports have steadily fallen. Between the years 1890 and 1900 the imports averaged more than 2,000,000 barrels a year, and in two or three subsequent years they approximated this amount; but after 1907 the falling off was very rapid.

The export business has slowly, but steadily, increased with the growing appreciation of the quality of American cements. Recent

export figures are somewhat misleading, for the reason that they include the shipments to Panama. The following tables give the figures of imports and exports:

IMPORTS OF FOREIGN CEMENT, 1878-1910, IN BARRELS

1878	92,000	1895	2,997,395
1879	106.000	1896	2,989,597
1880	187,000	1897	2,090,924
1881	221,000	1898	1,152,861
1882	370,406	1899	2,108,388
1883	456,418	1900	2,386,683
1884	585,768	1901	939,330
1885	554,396	1902	1,963,023
1886	915,255	1903	2,251,969
1887	1,514,095	1904	968,409
1888	1,835,504	1905	896,845
1889	1,740,356	1906	2,273,493
1890	1,940,186	1907	2,033,438
1891	2,988,313	1908	842,121
1892	2,440,654	1909	443,888
1893	2,674,149	1910	306,863
1894	2,638,107		

EXPORTS OF HYDRAULIC CEMENT, 1900-1910, IN BARRELS

1900	100,400	1906	583,299
1901	373,934	1907	900,550
1902	340,821	1908	846,528
1903	285.463	1909	1,056,922
1904	774.940	1910	2,475,957
1905	897,686		

Pennsylvania cement manufacturers are appreciating more fully each year the importance of developing export business, as the construction of large cement-making plants in the interior of the country restricts more and more the American territory in which they may profitably distribute their products.

Susquehanna Power—Water Supply

IN VARIOUS parts of the State hydro-electric power plants have been and are being installed to utilize the power of the rivers and streams. Two of the most notable of these enterprises are the McCall Ferry Power Company and the York Haven Power Company, both on the Susquehanna River, between Harrisburg and the Maryland line. Of these, the larger is that at McCall Ferry, which supplies power to the City of Baltimore, Md.

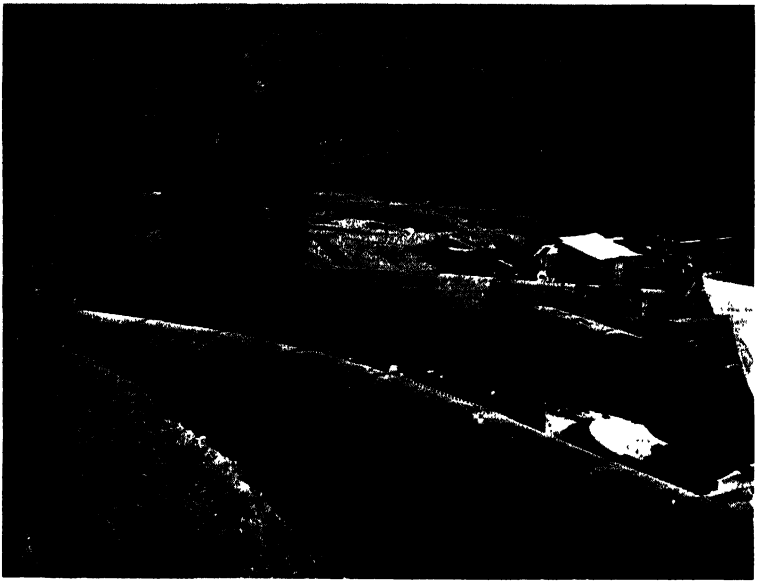
With the single exception of the St. Lawrence, the Susquehanna is the largest, as to flow and area drain, of the rivers emptying into the North Atlantic. Draining a basin which covers more than 27,000 square miles, it has a length of 200 miles between its rise in Otsego Lake and its mouth. It is, however, navigable for only a few miles inland from Chesapeake Bay. The main trunk of the river at its junction of the north and west branches at Sunbury has an elevation of 450 feet above sea level. The distance from this point to its entrance to the Chesapeake Bay at Havre de Grace is 121 miles, thus giving an average gradient of 3.7 feet per mile. The numerous rapids below Harrisburg, taken in connection with the larger discharge due to increasing area of watershed and attractive sites for dams, had long claimed the attention of engineers and others interested in water-power developments. The Susquehanna is so situated that it has exceptionally good markets for power.

The dry weather flow of the Susquehanna River at Harrisburg is better than that of most of the other large rivers in this State, and it is still better at McCall Ferry, owing to the large dry weather flow of Yellow Breeches and Swatara Creeks.

In October, 1905, the company began to clear the wooded hillsides a half mile below McCall Ferry for the construction of its immense plant. The plans provided for a spillway 2500 feet long, connected to the Lancaster County shore by a power house 500 feet long. The width of the river at this point is about 2700 feet. All parts of the work are designed for such a flood as will procure a flow of 17 feet over the crest of the dam, for that is the greatest flood ever known in the river. This was in 1889, the year of the Johnstown disaster. The power house has ten

units, each consisting of a pair of Francis type turbines mounted on vertical shafts. Each unit has a capacity of 13,500 mechanical horsepower.

The 7500 K.W. generators embody the latest practice. They are approximately 27 feet in diameter over all, and each weighs complete 145 tons. With each unit there is provided a brake, so that it may be



PENSTOCK FOR HYDRO-ELECTRIC PLANT IN MEXICO, BUILT BY RITER-CONLEY MANUFACTURING COMPANY, PITTSBURGH

brought to rest without undue delay, for such a spinning top is a revolving element weighing 335,000 pounds at 94 revolutions a minute, that if left to itself would run for many hours after the water is cut off.

The plant has a 53-foot head and about 3.75 square miles of pondage. It was designed to deliver from the stream flow alone 75 per cent. of its capacity, or 75,000 commercial horsepower, on an average of 311 days in the year, and its full capacity 285 days in the year.

It is the expectation that the future will see the construction of storage on the waters above the plant, which will largely increase the constant dependable flow.

Though the McCall Ferry dam is a solid concrete structure 50 feet

high, it is provided that this shall not be a bar to navigation should the river be improved later. The company is under obligations to install the necessary locks, should there be need of them in any future plan for the navigation of the river.

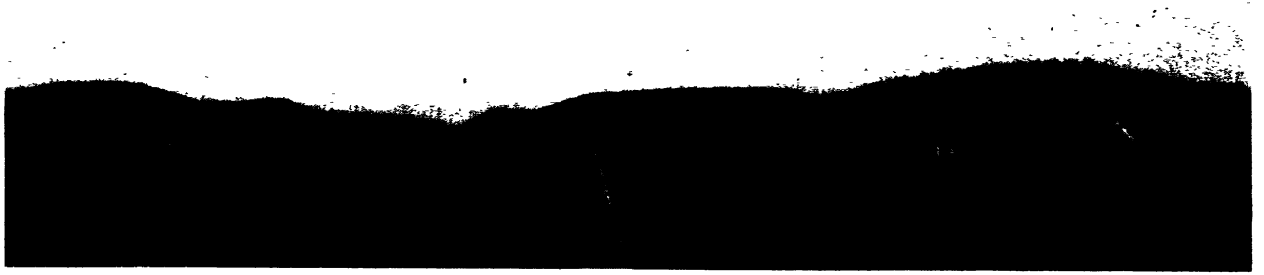
The York Haven Power Company distributes electric power to Harrisburg and York. The plant is of 20 units, each of 1100 horsepower.

The broad rivers of Pennsylvania, viewed solely as a means of communication, have been the chief factor in the development of the trade and industry of the State. The paths cut by them among its hills and mountains made possible the rapid advance of the railroads, whose roadbeds follow their winding courses. The Delaware on the east—the gateway of the State to the ocean; the Ohio on the west, giving access to the Mississippi and so to the Gulf of Mexico; the numerous rivers between them—have each borne its important part in the State's advance in prosperity.

Conservation of these waterways, their development to the fullest degree of usefulness, is a part of the policy of the State. The protection of the waters of Pennsylvania is placed in charge of the State Department of Health and the Water Supply Commission, of which both the Commissioner of Health and the State Forestry Commissioner are *ex-officio* members. Matters pertaining to distribution of the waters are controlled by the Water Supply Commission and the Forestry Commission, but matters relating to the purity of the waters, both above and below the ground, are under constant supervision and control of the State Department of Health.

There are extended areas in the eastern and western parts of Pennsylvania's mountain region, where the aggregation of population and the operations of man require more water than Nature supplies during droughts, and in other sections of Pennsylvania the uses of water are such that the supply must be regulated and conserved and the purity of the waters maintained to meet the demands of the people of the Commonwealth, present and prospective. The State has, after extended and comprehensive study of the subject, arrived at the conclusion that it is imperative that the waters of Pennsylvania be conserved as a resource equally with the soils and forests and coals and other natural resources.

The regulation of the flow of streams by the building of storage reservoirs to hold the freshet yields and deliver them uniformly throughout the year is a tremendously expensive undertaking, and will not result in



POWER PLANT AT MC CALL FERRY, SUSQUEHANNA RIVER

STONE BRIDGE SPANNING THE SUSQUEHANNA RIVER NEAR HARRISBURG, PENNSYLVANIA RAILROAD. LONGEST STONE BRIDGE IN THE WORLD. LENGTH, 3800 FEET. WIDTH, 52 FEET. 48 SEGMENTAL ARCHES OF 70 FEET SPAN. FOUR TRACKS

construction to any large extent, unless these storage reservoirs serve some other purpose. The storage of water must, from the economic basis, be brought about in conjunction with the development of power by that water and in conjunction with transportation problems.

Since its organization, in 1905, the Water Supply Commission of Pennsylvania has carried on a systematic examination of the domestic

POWER PLANT, HYDRO-ELECTRIC COMPANY, SCHUYLKILL RIVER, NEAR PHILADELPHIA

and industrial water-supply systems in the Commonwealth, involving the examination of all municipal, incorporated and many of the numerous small private water works. This work has now been completed. Each plant was visited and examined by a representative of the commission, and the facts ascertained incorporated into reports upon the conditions of the water supply of each county. Maps were prepared of each county, upon which were plotted the sources of supply of the various water-supply systems, pipe lines, reservoirs, points of distribution, etc., indicating the streams which are in use and the purpose or purposes to which they are devoted. In addition to this, all the charters granted by the State for water companies were investigated and their disposition and present status ascertained.

There is no single municipality or unincorporated community of over 2500 population which has not a public water-works system, while there are few communities having between 1500 and 2500 population not being so supplied, and where such exist it is usually due to the physical features of the surrounding country, character of the inhabitants, or legal difficulties preventing the use of favorable sources of supply. Most towns of over 1000 population are provided with public water supplies.

Statistics for 1909 show that there were 1751 water and water-power companies incorporated in the State of Pennsylvania, of which 851, or 49 per cent., are in active operation. Of the incorporated companies, 1474, or 84 per cent., are for the supply to the public; 126, or 7 per cent., for commercial and manufacturing purposes; 84 are water-power companies, and 67 were incorporated for both the supply of the public and for commercial and manufacturing purposes.

Probably the first water-works system to be put in operation in Pennsylvania is that supplying the village of Shaefferstown, Lebanon County, an unincorporated village of about 1000 population. This plant is now owned by the Shaefferstown Water Company, incorporated by Special Act in 1845. The works were built by a Mr. Shaeffer about 1732, and at his death were left to the town, each property owner on the main street becoming a stockholder, and all such stockholders paying 10 cents per head per year for each member of the family; others not stockholders pay 20 cents per head per year.

The first water works pumping plant in Pennsylvania was built at Bethlehem, Northampton County, in 1754, by Hans Christopher Christiansen. The water was obtained from a spring rising near Monocacy Creek and was pumped by means of water power into a wooden distributing tank. The first steam pumping plant in Pennsylvania was installed in Philadelphia in 1801, the water being taken from the Schuylkill River at the foot of Chestnut Street. On the site of the present City Hall was a secondary pumping station with elevated tanks, from which the distribution was effected. The earliest water company incorporated in Pennsylvania was the Water Pipes of Aaronsburg, incorporated by Special Act of the Legislature, March 25, 1809, for the supply of water in Aaronsburg village, Center County. The oldest incorporated water company which is still in active operation is the York Water Company, incorporated February 8, 1816, for the supply of water in the City of York. It was the second water company to be incorporated in Pennsylvania.

TRANSPORTATION IN PENNSYLVANIA

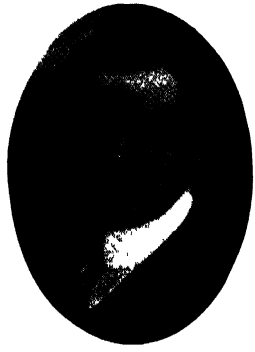
E. T. STOTESBURY
Chairman Finance Committee

DIMNER BEEBER
Chairman Committee on Patrons

JAMES B. BONNER
Chairman Committee on Hotel Accommodations

COLEMAN SELLERS, JR.
Vice-Chairman Committee on Inspection of Public Works

ALBA B. JOHNSON
Chairman Committee on Exhibition



GEORGE F. SPROULE
Sec'y-Treas. Local Organizing Commission

The Ruins of a Once Great System

THE history of transportation in Pennsylvania naturally divides itself into three great epochs: First, that of the state canals—a system which cost $100,000,000, only to be generally discontinued as a new and antagonistic force came into existence. Second, the great period of railroad development, during which the Commonwealth advanced with giant strides in material prosperity, and during which also the canals were, one after another, discontinued, forming in some of their

STAGE COACH ON RAILS OF THE MAIN LINE OF THE PUBLIC WORKS OF PENNSYLVANIA. THE TRACKS WERE RESERVED FOR PRIVATE CONVEYANCES DURING CERTAIN HOURS OF EVERY DAY

sections the roadbed of railroads. Third—and this epoch is now dawning—the epoch when canal development along modern lines will supplement the great railroad systems, already loaded to capacity with the vast carrying business of the State, and will lift from the railroads a part of the burden of such classes of freight as may be most profitably and satisfactorily waterborne.

Nor is it the view of advanced railroad men that this now-dawning era will mean any diminution of railroad prosperity, for it is confidently believed that the development of inland waterways will operate as a

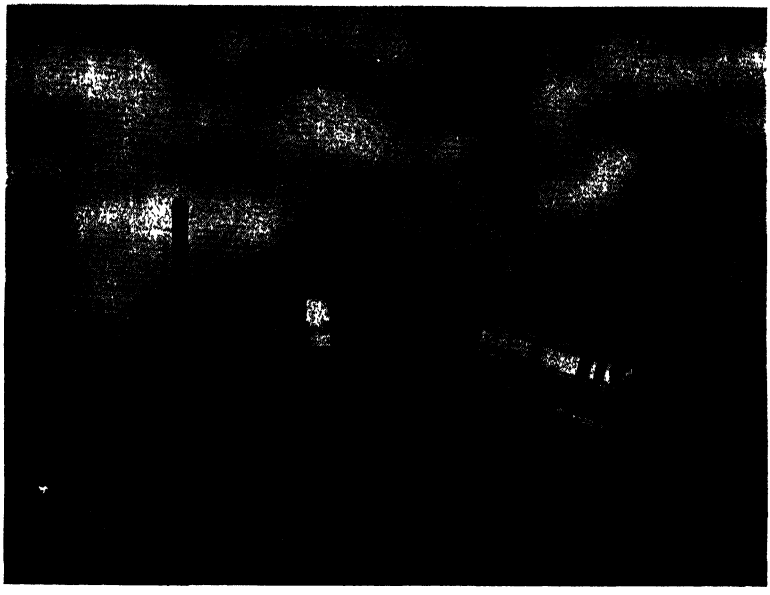
generally, since 1887. Since that year a constant effort has been made by the State to induce private individuals to practice forestry by allowing a rebate of taxes on forest lands, but in each case the laws have been declared unconstitutional, and the forestry authorities are still trying to have some law passed which will stand the test. The Forestry Association, during the last decade, has continued its activities in the matter of spreading forestry knowledge and keeping up the interest generally in forestry work. The women's clubs and the press of the State have assisted to an important extent in this work. Recently a State branch of the National Conservation Association has been organized, and has begun a work in the matter of spreading forestry information.

As compared with other States, Pennsylvania is undoubtedly in the lead in forestry work. In the number of acres owned, Pennsylvania is exceeded only by the State of New York; but, as Gifford Pinchot, former National Forester, has recently said, "Forestry is thriving everywhere in New York except in the forest." Pennsylvania not only has the public interested in forestry, but is doing practical forestry work on the lands which it owns. The reserves are being used in every possible way for the service of the people. Approximately 10,000 persons were on these lands for hunting and fishing purposes in 1911. There is no record of how many used them for other kinds of recreation.

A number of cities and towns receive a constant and pure supply of water from the protected watersheds within the forest reserves. The timber on these lands which is dead, dying, or defective is being placed upon the market and utilized as rapidly as possible. Whenever minerals of any kind are found, and it is thought wise to have them developed, leases are granted in accordance with law. On the South Mountains a large area has been set aside for the use of a sanatorium for tubercular patients. On a number of reserves large areas are set aside as game refuges.

new spur to industry, creating for the railroads—and leaving them freer to carry—a larger volume of profitable merchandise traffic.

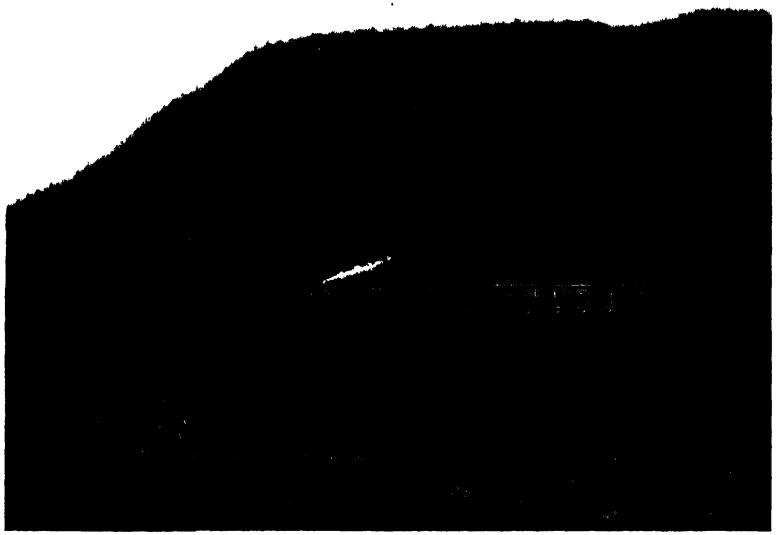
It was natural that the primitive canal system of the first half of the last century should be crushed out of existence in its fight to stem the tide of railroad supremacy. It is equally natural and logical that canal development should now come to supplement the railroads in the vast carrying business of the State and the Nation.



SUMMIT OF ALLEGHENY PORTAGE, MAIN LINE OF THE PUBLIC WORKS OF PENNSYLVANIA, SHOWING SECTIONAL CANAL BARGE ON WHEELED TRUCKS

The extensive system of canals, which in the middle of the last century was one of the glories of the Commonwealth, had its beginnings as far back as 1761, when commissioners were appointed, having authority for clearing, scouring, and making the River Schuylkill navigable for boats and small vessels generally. This improvement was to cover the distance from the Blue Mountains to the Delaware River. This may be regarded as the inaugural step in the creation of the Schuylkill Navigation Company, which bore so important a part in the development of the great natural resources of the State, and whose subsequent works were monuments of early engineering skill.

The actual construction of the canal system itself, however, may be dated back to 1791, when the sum of £25,720 was appropriated for the construction of waterways, removing obstructions from the rivers, and building the roads to connect links forming the line of water communication. This was the beginning of a great system which, in time, spread as a tree over the State, having as its stem the Main Line Canal.



From Painting in State Capitol, Harrisburg, Pa.

TRAIN ON THE OLD STATE PORTAGE RAILROAD CROSSING THE ALLEGHENY MOUNTAINS. CANAL BARGES WERE TRANSPORTED IN SECTIONS SET ON WHEELED TRUCKS. THESE MADE THE ENTIRE TRIP BETWEEN PHILADELPHIA AND PITTSBURGH, BEING TAKEN OFF THE TRUCK FOR THAT PORTION OF THE JOURNEY WHICH WAS ACCOMPLISHED BY CANAL

These were, however, but beginnings, and it was not until the administration of John Andrew Shulze as Governor that, in 1823, the demand for a system of internal waterways improvements became insistent. It was in accordance with this demand that an act of Assembly was passed in 1824, under which commissioners were appointed to survey and explore a route for a canal from Harrisburg to Pittsburgh, by the

waters of the Juniata and Conemaugh rivers. Under an act passed in 1825, surveys were begun preparatory to the establishment of a navigable communication between the eastern and western waters of the State and Lake Erie. In 1826 an act was passed "to provide for the commencement of a canal, to be constructed at the expense of the State, and to be styled The Pennsylvania Canal." This was to extend from the River

COPY OF AN OLD TRAFFIC ANNOUNCEMENT FOR THE MAIN LINE OF THE PUBLIC WORKS OF PENNSYLVANIA

Swatara, at or near Middletown, to a point on the eastern side of the Susquehanna River opposite the mouth of the Juniata, and from Pittsburgh to the mouth of the Kiskiminetas. Further, the commissioners were authorized, as soon as they should deem it expedient and practicable, to construct a navigable feeder from French Creek to the summit level of Conneaut Lake, and to survey and locate the route of a canal from thence to Lake Erie. Further extensions were authorized in the succeeding year, when it was planned to locate and contract for the making of a canal and locks up the valley of the Juniata, from the eastern section of the Pennsylvania Canal to a point near Lewistown; also a canal and locks up the valley of the Kiskiminetas and the Conemaugh from the western

section of the Pennsylvania Canal to a point at or near Blairsville; also a canal and locks up the valley of the Susquehanna to a point at or near Northumberland.

The greatest period of activity in canal construction began in 1827. In this year surveys were made of the Juniata Valley, and for a portage road over the Allegheny Mountains, to ascertain the best mode of con-

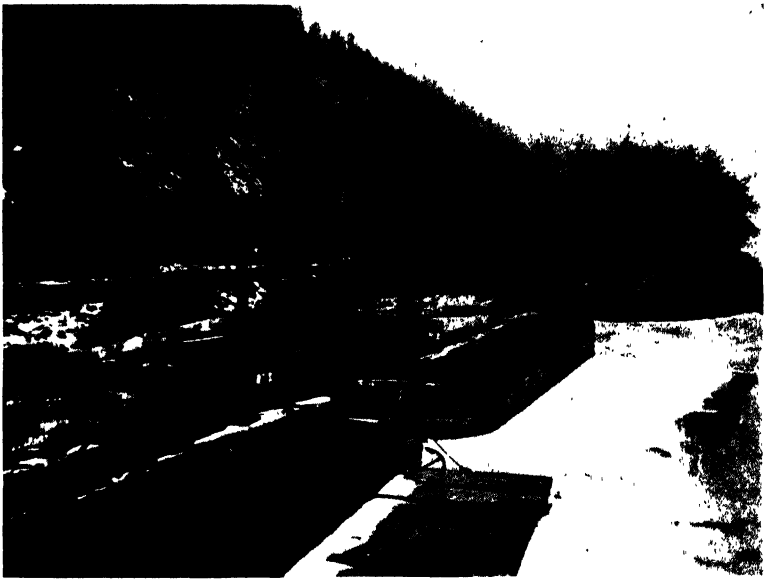
Photograph by Wilfred H. Schoff.

DECAYING CANAL BOAT, IN ABANDONED CANAL, SUSQUEHANNA RIVER, NEAR HARRISBURG

necting the lines east and west. Also for a railway to extend from Philadelphia to Columbia; also a survey to ascertain the practicability and cost of forming a connection of the North Branch of the Susquehanna and the Lehigh. A survey was also ordered down both sides of the Susquehanna River to the Maryland line. The act which authorized these also authorized, among other surveys, one along the Delaware River between Philadelphia and Bristol, and the immediate commencement of work on this canal in the direction of Easton.

Even before the activities of the State began, incorporated companies had started works of improvement. The Schuylkill Navigation

Company Canal, covering a distance of 108 miles up the Schuylkill Valley from Philadelphia, was constructed, with 71 locks to overcome the elevation from tidewater, which amounted to 618 feet between Philadelphia and the upper terminus, at Mill Creek. Through this one canal there plied, in 1865, 1000 boats, having an average carrying capacity of 170 tons. Through this single canal there were carried 1,500,000 tons



Photograph by Wilfred H. Schoff.

ABANDONED CANAL BARGES AND STEAM TOWBOAT AT ENTRANCE TO ABANDONED CANAL LOCK. SUSQUEHANNA RIVER, NEAR HARRISBURG

of coal, lumber, iron ore, and other products of the mines. Up to this year the canal had cost $12,250,000. Another of these enterprises was the Lehigh Coal and Navigation Canal, authorized by the Legislature of 1818 and intended primarily to carry the coal tonnage of the Lehigh Company mines to Philadelphia.

The Union Canal, 77 miles long, extended between Middletown and Reading, via Lebanon, with a branch 22 miles from a point where the canal left the Swatara Creek to Pine Grove, in the Schuylkill coal region. Through this canal were shipped large quantities of iron ore to Danville and other points, and coal was returned from the Wyoming region, for

use in the furnaces at Lebanon. There were, however, in this canal no fewer than one hundred lift-locks, and the great expense of lockage was already detrimental to the shippers and carriers. In 1885 this canal, which cost more than $6,000,000, was sold by the Sheriff of Philadelphia.

Among the successful enterprises of the early years of the last century was the Monongahela Navigation Company. This was formed by

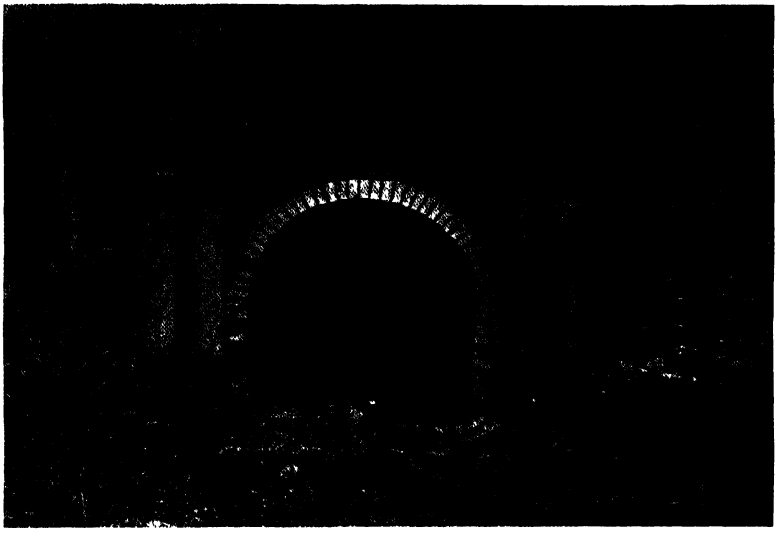
PASSENGER STATION AND HOTEL, AND PASSENGER TRAIN, AT SUMMIT OF THE ALLEGHENY PORTAGE, MAIN LINE OF THE PUBLIC WORKS OF PENNSYLVANIA

private subscription. Sixteen dams were constructed across the Monongahela River, in order to form slackwater navigation with locks connecting the pools. In 1870 the invested capital was $1,003,500, and upon this capital 10 per cent. dividends were divided. The annual tonnage was 2,246,000, of which 2,188,000 tons were bituminous coal. In 1880 the coal tonnage was increased to 3,193,800, and a dividend of 12 per cent. was paid on the capital stock. In 1890 the capital had been increased to $1,632,000, and a 9 per cent. dividend was paid. In 1897 the United States Government assumed possession of the work under condemnation proceedings, and it has since been maintained as a free waterway.

Thus the great system spread fanlike over the State. Its construc-

tion involved many pieces of engineering skill, as, for instance, a tunnel 600 feet long just west of Lebanon, with a flight of 16 locks, carrying the canal to Swatara Creek. This has long since been a crumbling ruin, a fallen monument to the early canal enterprise.

The Portage Railroad, over the Allegheny Mountains, was described by David Stevenson, in 1838, as "a mountain railway which,



ALLEGHENY PORTAGE TUNNEL, WEST FACADE

in boldness of design and difficulty of execution, compared only with the Simplon Pass and Mont Cenis, in Savoy." This road was a section of the Main Line Canal, and formed a part of what is now the Pittsburgh Division of the Pennsylvania Railroad. The mountains were crossed by means of a system of inclined planes with stationary power. The total rise from tidewater was 2585 feet. The different planes overcame elevations ranging from 130 feet up to 307 feet. The steepest ascent was 10¼ feet in 100. There will, of course, never be a simpler, more graphic picture of this mountain road than the following, in Charles Dickens' "American Notes," written of his journey in 1842:

"We had left Harrisburg on Friday. On Sunday morning we arrived at the foot of the mountain, which is crossed by railroad. There are ten inclined planes, five ascending and five descending; the carriages are dragged up the former and let slowly down the latter by means of

stationary engines, the comparatively level spaces between being traversed sometimes by horse and sometimes by engine power, as the case demands. Occasionally the rails are laid upon the extreme verge of a giddy precipice, and, looking from the carriage window, the traveler gazes sheer down, without a stone or scrap of fence between, into the mountain depths below. The journey is very carefully made, however, only two carriages traveling together; and, while proper precautions are taken, is not to be dreaded for its dangers."

The journey westward over the "Main Line of the Public Works of Pennsylvania" began at Broad and Vine streets, Philadelphia. Between that point and Columbia, on the Susquehanna, rails were laid which carried sectional canal boats set on wheel trucks, and also passenger coaches. These were hauled originally by animal towage. They moved over the Schuylkill River, then up the Belmont inclined plane by steam power, and then to Columbia by animal power. There the canal boat sections were pinned together and put on the river, while the passengers took canal packets. The traffic moved up the Susquehanna and Juniata rivers to the basin at Hollidaysburg. It then moved up the Portage Railroad and again down the mountain to Johnstown. From this point it proceeded through the Conemaugh, Kiskiminetas, and Allegheny Rivers to Pittsburgh.

This was a public work on which every citizen had the right to travel in his own conveyance. After the importation of locomotives from England part of the day was reserved for public conveyance and part for the use of the line by private citizens.

In the main, this great system of engineering works, which covered almost every section of the State, is now a heap of ruins. Here and there a canal bed, tangled with thicket, or the mud-imbedded wreck of a canal boat marks a path that once was busy with moving commerce.

The State government did not have the machinery adequate to operate this system, and the most effective service was given by private companies operated under State license. The State was, therefore, entirely willing to turn over the system to railroad control, and, in turning it over, much went and was discontinued that, in the belief of many canal advocates to-day, should have been preserved, and could still be profitably used.

Investigation discloses that during the period of canal development charters were granted to more than one hundred companies. Many of these had a great diversity of rights, including the maintenance of turnpikes, and, in some cases, even the conducting of insurance business.

A Survivor of the Canal-Railroad War

IS THE theory of those who are pressing for a continuous inland waterway from New England to the Gulf of Mexico practical? Or has the development of railroad transportation along the seaboard made canalization of the minor waterways along this chain impractical, except, possibly, as a factor in the control of railroad rates?

Fortunately for those who hold that even the minor links of such a canal chain would at once demonstrate their value to commerce, there still exists in Pennsylvania an object lesson of what may be done in the way of economical transportation of freights with a canal of even the restricted dimensions that were considered adequate when the Pennsylvania canal system was in its zenith, more than half a century ago.

This is the Lehigh Coal and Navigation Canal, which extends from Bristol, Pa., to Mauch Chunk. In every respect this canal is operated under the most difficult and forbidding conditions. It has no less than seventy-five locks, and it reaches, at Mauch Chunk, an elevation of 531 feet. It can accommodate canal boats of only 100 gross tons. The upkeep cost may be considered as the maximum. Yet to-day this most difficult of canal enterprises, nearly a century behind the times in its dimensions, is transporting coal and other commodities on a basis of cost that makes its existence still advisable and profitable. This is largely due to efficient management; yet as an object lesson in the possibilities of canalization, the Lehigh Coal and Navigation Canal holds a peculiar interest to-day for the advocates of inland waterway improvement.

This survivor of the early Pennsylvania canal system, which came through the war between canals and railroads, dates its existence to the first quarter of the last century.

The canal was brought about by the need of a means of transportation of the coal of the Mauch Chunk region to Philadelphia, which was the principal market. It was only after the mines of the Lehigh Coal Mine Company had lain idle for years because of the impossibility of floating the coal to market that the first steps were taken for the improvement of a water route to the Delaware.

The only canals in navigable order in Pennsylvania at that time were one of about two miles in length, at York Haven, on the Susquehanna, and one made by Josiah White, at the Falls of Schuylkill, with two locks and a canal length of three or four hundred yards.

It was under these circumstances that the Legislature of 1818 granted the privileges of the "Act to improve the navigation of the River

LEHIGH GAP

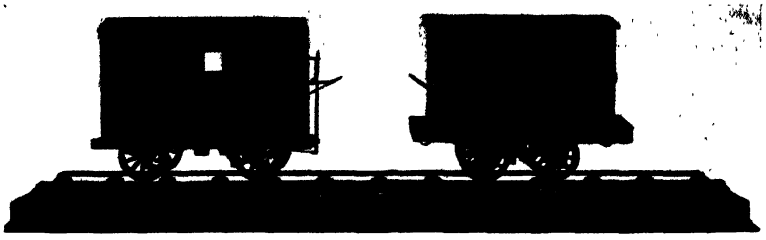
Lehigh" to Josiah White, George F. A. Hauto, and Erskine Hazard. These gentlemen were at that time pointed at as extremely visionary, and even crazy, for accepting the terms.

In the first stages of the improvement, water was accumulated by artificial means, and let off at stated periods. The boats were passed down with the long wave thus formed, which filled up the channel.

This was effected by constructing dams in the neighborhood of Mauch Chunk, in which were placed sluice-gates of a peculiar construction, invented for the purpose by Josiah White, one of the managers, by means of which the water could be retained in the pool above until required for use. When the dam became full, and the water had run over it long enough for the river below the dam to acquire the depth of the ordinary flow of the river, the sluice-gates were let down, and the boats, which were lying in the pools above, passed down with the artificial flood. About twelve of these dams and sluices were made in 1819. With what work had been done in making wing dams, this

absorbed the capital of the company—which, on the first plan of improvement, would have been adequate—before the whole of the dams were completely protected from ice freshets. They were, however, so far completed as to prove, in the fall of that year, that they were capable of producing the required depth of water from Mauch Chunk to Easton.

On the 21st of April following, the Lehigh Coal Company and the



OLD PORTAGE PASSENGER AND FREIGHT CAR

EARLY TRANSPORTATION IN PENNSYLVANIA

Lehigh Navigation Company agreed to amalgamate their interests, and to unite themselves into one company, under the title of the "Lehigh Navigation and Coal Company," provided the additional sum of $20,000 was subscribed to the stock by a given date. Of this sum nearly three-fifths were subscribed by White and Hazard. With this aid the navigation works were repaired, and 365 tons of coal sent to Philadelphia as

the first fruits of the enterprise. This quantity of coal completely stocked the market, and was with difficulty disposed of in the year 1820. No anthracite coal came to market from any other source than the Lehigh before the year 1825, as a regular business.

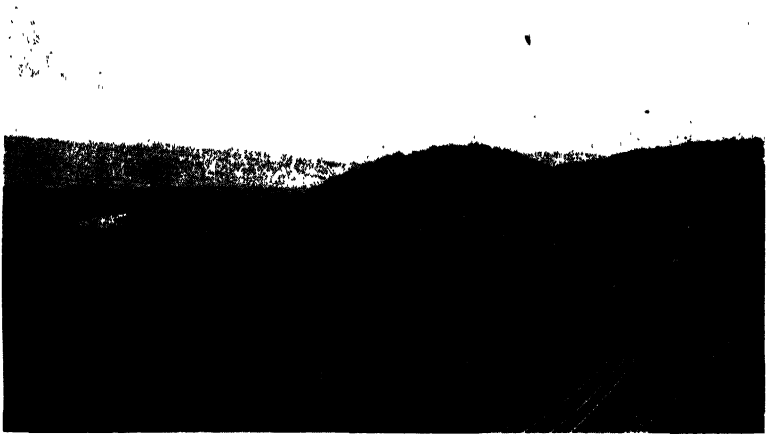
In the early days coal was brought to Philadelphia in what were termed "arks"—square timber boxes from sixteen to eighteen feet wide

LOCK IN THE LEHIGH CANAL

and from twenty to twenty-five feet long. These boats made but one trip. When they reached Philadelphia, and had been unloaded, they were broken up and the timber sold, the spikes, hinges and other hardware being returned to Mauch Chunk, a distance of 80 miles. For two or three years the hands employed on these rude boats made the return trip to the mines afoot. Later, rough wagons were placed on the road by tavernkeepers, to carry them at low fares. Boats of this sort were used until the end of the year 1831, when the Delaware Division of the Pennsylvania Canal, built by the State as a division of the public works, was partly finished. In the last year of this period 40,966 tons were thus floated down, requiring so many boats that, if placed in one line, they would have extended more than thirteen miles.

The Lehigh slackwater navigation from Mauch Chunk to Easton was opened for use at the close of June, 1829, while the Delaware Division was not regularly navigable until nearly three years afterward. The want of improvement of the Delaware Division, after the Lehigh

was completed, caused the failure of several dividends to the Lehigh Company. This was owing to the fact that the company was obliged to continue the use of temporary boats, which were very expensively moved on the Lehigh navigation, but which were the only kind that could be used on the Delaware River. To this fact, too, is attributable a very rapid advance made by the Schuylkill coal interests in this period. The atten-



EVOLUTION OF TRANSPORTATION IN FOUR STAGES: 1. JUNIATA RIVER, WITH ROWBOAT. 2. PENNSYLVANIA STATE CANAL, WITH BARGE. 3. PENNSYLVANIA RAILROAD, ORIGINAL ROADBED. 4. PENNSYLVANIA RAILROAD, MODERN ROADBED

tion of persons desiring to enter into the coal business was directed to the Schuylkill region, which advanced with great rapidity.

In the spring of 1827 it was decided that the company was strong enough to begin to prosecute the ascending navigation. A difficult point to decide was the size of the canal. Engineers who had written on the subject in England and America recommended an improvement to carry boats of 25-ton capacity. The acting managers at Mauch Chunk, White and Hazard, on the other hand, contended for an improvement that would accommodate boats of 130 to 150 tons burden. It was their contention that, as the Lehigh and the Delaware "afforded plenty of water for a navigation of the largest class, it would be suicide to permanently deprive the company and the public of the very best application of the means nature had afforded them." The debate on this question was

waged for an entire day, and, finally, the broad-minded policy of the managers prevailed to the extent that it was decided that the locks should conform to the size of "the Chesapeake and Delaware Canal, 22 feet wide, 100 feet long, and 5 feet depth of water, with a width of canal at bottom of 45 feet."

How far the early managers were in advance of their day is shown by the absorbing little volume that deals with this great enterprise, "Josiah White's History Given by Himself."

Mr. White says, "The truth is, if we had adopted the old plan of locks of low lift, the work, when done, would be too tedious in passing the locks to be of any value to our company or to the public. And we have now lived to see the day that the public and engineers are as much opposed to small canals and small locks as they were at the beginning of our canal opposed to large canals and locks. And the rival companies (Schuylkill and others) are making their canals and locks over again to get them large, so as to meet our rivalship and that of the railroad."

The Lehigh Coal and Navigation Canal as it is to-day is best described by the following figures:

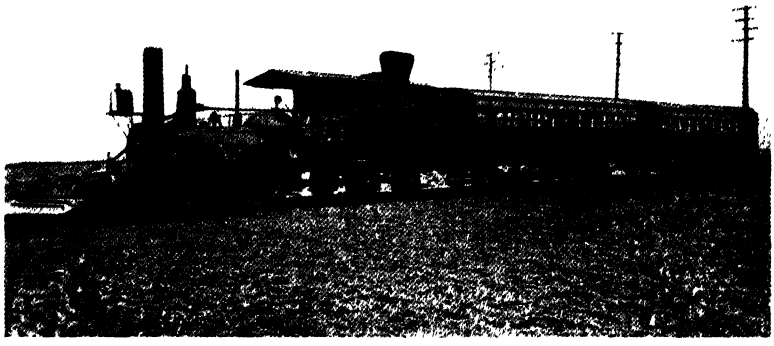
Route of canals—Mauch Chunk to Bristol, via Easton	Lehigh Division	46 miles.	50 locks
	Delaware Division	60 miles.	25 locks
	Total	106 miles.	75 locks
Depth of canals	Lehigh Division	6 feet average	
	Delaware Division	6 feet average	
Width of canals	Lehigh Division	63 feet at water line	
	Delaware Division	43 feet at water line	
Depth of locks	Lehigh and Delaware divisions	6 feet	
Width of locks	Lehigh Division	22 feet	
	Delaware Division	11 feet and 22 feet	
Length of locks	Lehigh and Delaware Divisions	90 feet	
Number of boats belonging to Lehigh Coal and Navigation Company		187	
Number of boats belonging to individuals		20	
Size of boats	Length, 87 feet; beam, 10 feet 6 inches; depth, 6 feet 9 inches.		
Capacity of boats	100 gross tons.		

Tonnage	1910 Tons of	1911 Tons of
Anth. Coal	323,800	320,000
Bit. Coal and miscellaneous	32,250	37,900

The canal terminal on the Delaware is at Bristol, 18 miles above Philadelphia. The elevations from which the canal-boats must be

lowered through 75 locks, and to which they must be raised, are: Mauch Chunk, 531 feet; Bethlehem, 235 feet; Easton, 217 feet; New Hope, 48 feet; Bristol, 18 feet.

The following lines, steam and electric, touch the canal: Central Railroad of New Jersey and the Lehigh Valley Railroad from Mauch Chunk to Easton, Chestnut Ridge Railroad, Lehigh and New England



PENNSYLVANIA RAILROAD COMPANY. THE ORIGINAL LOCOMOTIVE "JOHN BULL" AND TRAIN, 1831. BUILT IN ENGLAND, BY STEPHENSON & CO., FOR THE CAMDEN AND AMBOY RAILROAD COMPANY

Railroad, Philadelphia and Reading Railway, Pennsylvania Railroad, and the Easton and Doylestown trolley.

That this canal, despite its proximity to these roads, despite its limited dimensions, despite its 75 locks and its maximum elevation of 531 feet, cannot even to-day be considered moribund is shown by its recent history. In the year 1907 a careful and systematic investigation of the problems of canal traction, with a view to the ultimate substitution of mechanical for animal towage, was carried on upon a practical scale; the conclusion being that an expenditure for this purpose will be abundantly justified with an annual traffic of 450,000 to 500,000 tons, to which point it is thought probable that the business of the canal can be developed. A stretch of the canal has been equipped with electric towage, and experiments have also been made with producer-gas canal tugs. In the year 1910 there were built and put into service 35 new boats. Modern terminals for the storage of anthracite coal have been constructed on the Delaware River front, Philadelphia.

Calculations based upon the cost of transporting coal from the company's mines show that this narrow gauge, freshet-menaced canal may still be profitably operated. And it has been more than once a thorn in the side of that triumphant foe of the early canals—the railroad. When, some time since, it made a favorable rate on sugar into Easton, that rate was met so that the sugar would move by rail. Notwithstanding such difficulties, it has, in recent years, slowly but surely increased its tonnage.

The Ninety-first Annual Report of the Board of Managers for the fiscal year ending December 31, 1911, makes the following showing for the canal: "The Delaware Division Canal was opened for navigation on March 8, 1911, and the Lehigh Canal, March 29, 1911. Both canals were closed November 30, 1911. Heavy rains and consequent freshets during June and August last caused a complete suspension of boating on the Lehigh Canal for nearly a month. Notwithstanding this loss of time, there were moved during the season of 1911 a total of 361,070 tons, of which 319,989 tons were anthracite coal. The total tonnage during the 1910 season was 364,971 tons, of which 323,808 tons were anthracite coal.

"The operating results for both canals for the year 1911 show a satisfactory comparison with that of the year 1910. The net revenue in 1911 was $32,897.98, compared with $22,264.26 in 1910, an increase of $10,633.72."

The Pennsylvania Railroad

THERE was a day when a statue perhaps a hundred feet in height, which bestrode a harbor entrance, was classed as one of the seven wonders of the world. What—as compared to this—of the driving of tubes of steel beneath the waters of a modern harbor, tubes through which move the world's finest trains? A wonder greater than any of the seven has been raised by Pennsylvania enterprise. Austin Corbin dreamed of tunnels underneath the waters of New York harbor. Alexander Johnston Cassatt, backed by the millions of the Pennsylvania Railroad and with a courage that marked him as the first of American railway presidents, made that dream a reality.

The act incorporating the Pennsylvania Railroad was passed by the Legislature in 1846. From its beginning, the company has kept steadily to the front in the march of American railroad improvement. It was the first to use steel rails in 1863, to use Bessemer steel rails in 1865, to use the air-brake in 1866, the track tank in 1872, and the signal block system in 1873. Its history from the beginning has been one of constant achievement, crowned by the opening of its tunnels and its terminals in the city of New York.

The Pennsylvania has been termed the greatest single factor in American transportation affairs. Nearly every important eastern gateway into or out of a territory of large tonnage supply will be found guarded by a Pennsylvania Railroad line. The system east of Pittsburgh may well be likened to a river into which flow numerous streams of traffic swelling the main artery to Amazon size from Harrisburg to New York. There are dozens of these feeders, each with its own arms, reaching out to tap rich sources of raw material or their product. They radiate through the territory south and immediately east of Pittsburgh; they form a network of tracks north of the main line between Johnstown and Altoona, and send in a flood of traffic from the south at Harrisburg and at Philadelphia. This takes no account of the lines reaching up to the lakes and occupying a resourceful region in northwest Pennsylvania. Neither does it include the occupation of Long Island by the Pennsylvania and the gradual spread of Pennsylvania influence into New England.

Taking a Pennsylvania carload to average 30 tons, it would require 4,300,000 cars to move at one time the 1910 business, or twice as many freight cars as there are in existence in the United States.

Once in every ten years the Pennsylvania Railroad doubles its tonnage and adds from 40 to 50 per cent. to its capacity. The Pennsylvania Company, all of whose $80,000,000 of stock is owned by the Pennsylvania Railroad Company, operates a great railroad system west of Pittsburgh.

Controlling less than 5 per cent. of the railroad mileage of the United States, the Pennsylvania moved, in 1910, 27½ per cent. of all of the revenue freight and earned 13½ per cent. of all gross revenues. It owned 12 per cent. of all steam locomotives, not quite 12 per cent. of all freight cars, and 13 per cent. of all passenger cars.

Although embracing over 11,000 miles of line, the Pennsylvania is operated through three score or more divisions, covering nearly 140 separate corporations that go to make up the Pennsylvania Railroad Company. Many of these divisions turn into the treasury monthly revenues that will equal a whole year's income on dozens of American railroads. Train movements are so frequent and the volume of traffic so enormous that the area of individual supervision is limited, in maintenance of way work for example, to twenty-five miles, whereas the same inspection responsibility on a western or southern road would cover several hundred miles. To show the immense earning capacity of the three grand divisions of the Pennsylvania, their receipts for 1910 are contrasted with those of several important American railroad systems, as follows:

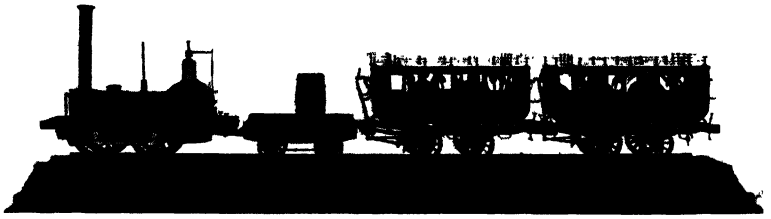
	Mileage	Gross Earnings
Pennsylvania Railroad (East Pennsylvania Division)..	1,340	$59,184,146
Illinois Central	4,451	$57,884,721
Southern Railway	7,650	57,294,508
Louisville and Nashville	4,554	52,433,382
Missouri Pacific	6,775	53,019,137
New York, New Haven and Hartford	2,042	60,693,638
Erie	2,227	51,830,720
St. Louis and San Francisco	5,182	41,165,938

The New York tunnel project was an enterprise without precedent in the history of transportation. The river tunnels which lead to the new station on Manhattan are, all told, 6.8 miles long, and the land tunnels have the same length.

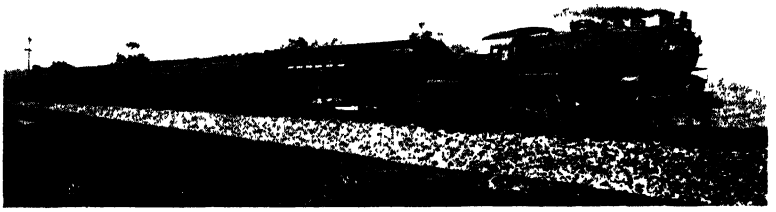
From the Bergen Hill portal in New Jersey to the Long Island entrance of the tunnels it is 5.3 miles. It is 8.6 miles from Harrison,

N. J., to the station in New York, while from the latter point to Jamaica the distance is 11.85 miles.

The maximum capacity in trains per hour is 114. In the construction of the tunnels, strength, safety and permanency were considered rather than money cost. The tunnels or tubes consist of a series of iron rings, and the installation of every ring meant an advance of 2½



"JOHN BULL" AND TRAIN, IN ORIGINAL CONDITION

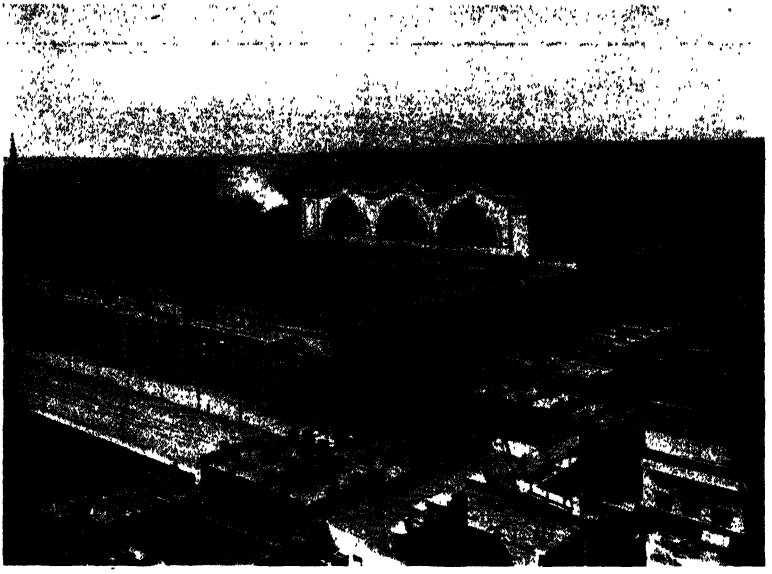


"PENNSYLVANIA SPECIAL," NEW YORK TO CHICAGO IN 18 HOURS

feet. Eleven segments and a key-piece at the top complete the circumference, and an entire ring weighs about fifteen tons. The cast-iron plates, or sections of the ring, have flanges at right angles to the surface, and it is through these that the successive rings are held together with bolts. The record progress in one day of eight hours was five of these rings, or 12½ feet. Hydraulic rams, placed against the flanges every few inches around the tube, were used to push forward the 194-ton shields with which the tunnels were bored. After the tubes had been run from end to end they were lined with 22 inches of concrete.

The shields in the north tube under the Hudson River met on September 17, 1906. The accuracy of the calculations is shown by the fact that though each had traveled 3000 feet through a river bed, the meeting

was perfect. The shields in the four East River tunnels met as perfectly as those in the Hudson River. The entire work of construction occupied nine years of planning and labor. The motive power used in the tunnels is exclusively electric, and the entire equipment of the trains is of steel. By the use of electricity, smoke is eliminated, and a special ventilating plant keeps the tunnels supplied at all times with an abundance of



THE PENNSYLVANIA STATION, NEW YORK CITY

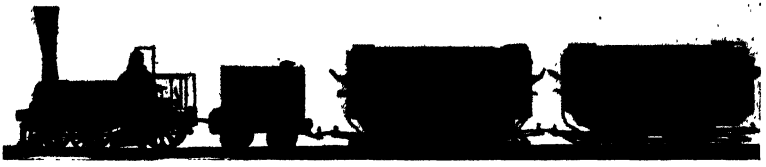
fresh air, although the motion of the passing train is ordinarily sufficient to give complete ventilation. The extraordinary thickness of the walls of the tubes excludes dampness.

The New York station, which completes this great terminal improvement, is 784 feet long and 430 feet wide. The length of the twenty-one standing tracks at the station is 21,500 feet.

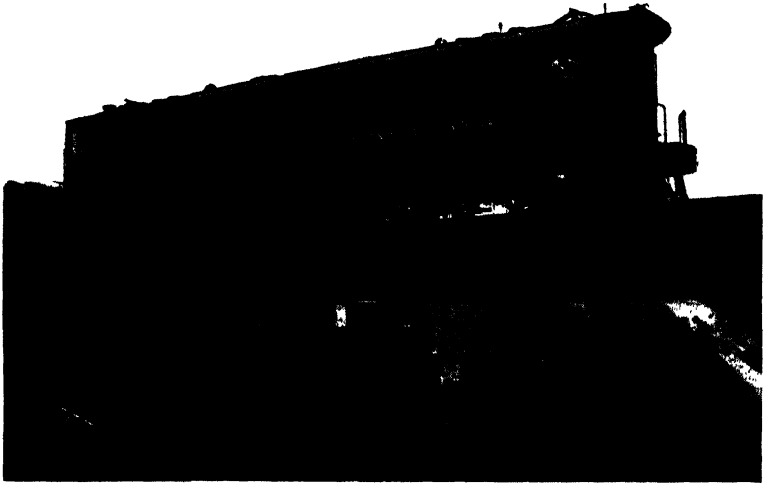
The total cost of the tunnel extension to December 31, 1910, as given in the report for 1910, including real estate not permanently required for its use, and conservatively estimated to be worth between seven and eight millions of dollars, and not yet disposed of, was $112,965,415.52.

Apart from its activities along strict railroad lines, the Pennsylvania has shown a progressiveness that well entitles it to its name as the leader among American railroads. In its forestry operations, for instance, the

management has been in line with the conservation policies of the States and the Nation. During the year 1910, 650 acres of idle land were set out in hardwood and evergreen seedling trees supplied by the company's



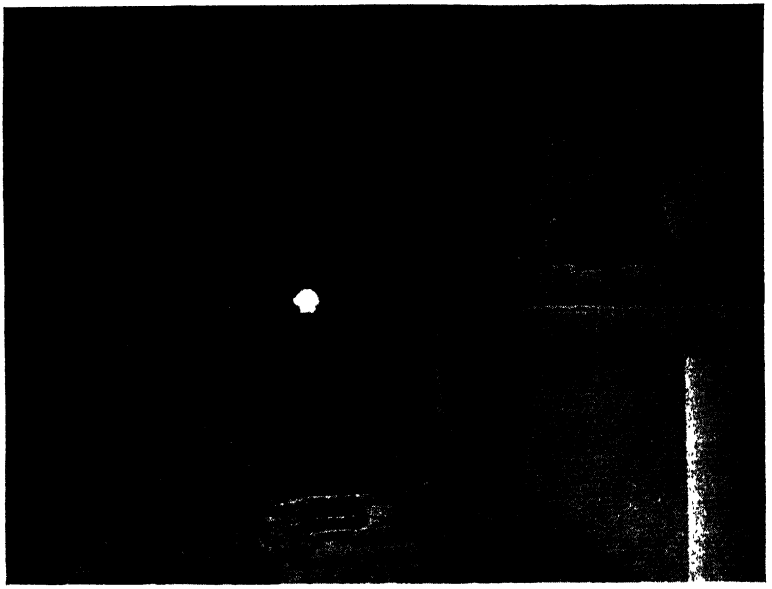
LOCOMOTIVE "LANCASTER" AND TRAIN



PENNSYLVANIA RAILROAD COMPANY 4000-HORSEPOWER ELECTRIC LOCOMOTIVE FOR NEW YORK TERMINAL. BUILT BY THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY

nursery at Morrisville, Pa. Thirty-two and one-half acres of land are devoted to nursery purposes, which afford a capacity of 1,000,000 trees a year. The total output of the company's nursery during the year 1910 was 766,924 trees. The stock on hand at the nursery at the close of the year was nearly 1,500,000 forest trees, varying in age from eight months

to four years, and 137,200 ornamental plants. Indicative of the scope of these forestry operations—the largest ever undertaken by any corporation —is the following table showing planting done in the last ten years:



INTERIOR OF HUDSON RIVER TUNNELS, PENNSYLVANIA RAILROAD

Years	Number of Trees Planted
1902	13,610
1903	43,364
1904	223,656
1905	597,165
1906	801,625
1907	448,226
1908	300,530
1909	1,054,010
1910	617,338
1911	515,703
Total	4,615,227

With a view to beautifying the lawns around the stations and unoccupied places along the roadway, much attention has been paid to the growing of ornamental plants and trees at the company's nursery. To save much of the time required to grow these from seed, there were imported from France during the year 1910, 41,699 deciduous ornamental

plants, 5480 coniferous ornamental trees, and 107,935 coniferous forest seedlings. In addition to growing ornamental shrubbery and trees for its future requirements of ties and lumber, the Pennsylvania Railroad Com-

PENNSYLVANIA RAILROAD TUNNELS UNDER THE HUDSON RIVER, BERGEN HILL PORTALS

pany has established two large tie and timber-treating plants, both using the pressure treatment, one at Mt. Union and the other at Greenwich Point, Philadelphia. These plants have a combined capacity per year of 1,500,000 cross-ties or their equivalent.

Another illustration of the enterprise of the road is its experimental work for the benefit of farmers. The Long Island Railroad has two experimental farms, which have been in operation for about six years. When the Long Island Railroad established its first demonstration farm many scoffed at the idea, and termed those interested in the enterprise "book farmers." They said it was impossible to grow anything on the waste land chosen for the experiment. The scoffing changed to admiration when in two years the Long Island had succeeded in cultivating successfully 380 different varieties of plants.

In the fall of 1908 President James McCrea, of the Pennsylvania

Railroad, made a trip of three days over the railroad lines on the Delaware-Maryland-Virginia Peninsula. He saw thousands of acres of this section —a rich agricultural district—idle, with the adjoining farms flourishing, and the products of the latter in great demand in all of the large markets of the Middle and Eastern States. As a result of his trip a farm of 50 acres was purchased at Bacon, Del., on the Delaware Railroad. This was

FREIGHT HAULING THROUGH THE ALLEGHENIES, PENNSYLVANIA RAILROAD

waste land covered with thicket, the purpose being to test what could be done with land of this forbidding character. Remarkable results were obtained with various crops.

This work is based upon the soundest kind of railroad policy. It is showing what results may be obtained by intensive farming on the old lands along the lines, and in this way is attracting farmers and developing traffic. These secondary branches of activity are but a part of the broad, general policy which has given the Pennsylvania Railroad its high place in the transportation history of the United States.

The record of transportation lines owned and operated by, and associated in interest with, the Pennsylvania Railroad shows that out of a total of 11,503.76 miles of lines, the length of lines in the State of Pennsyl-

vania is 4134.07. The length of lines in the various States in which the system operates is as follows:

STATES	LENGTH OF LINES—December 31, 1911		
	Total Miles East of Pittsburgh and Erie	Total Miles West of Pittsburgh and Erie	Total Miles All Lines
Delaware	275.34	.....	275.34
District of Columbia	13.02	.....	13.02
Illinois	.....	642.43	642.43
Indiana	.....	1,659.92	1,659.92
Kentucky	.....	4.07	4.07
Maryland	601.90	.....	601.90
Michigan	.....	439.99	439.99
Missouri	.....	30.78	30.78
New Jersey	780.17	.....	780.17
New York	822.57	.....	822.57
Ohio	.....	1,932.56	1,932.56
Pennsylvania	3,734.20	399.87	4,134.07
Virginia	77.87	.....	77.87
West Virginia	24.47	64.60	89.07
Total miles	6,329.54	5,174.22	11,503.76

The length of tracks on the lines east and west of Pittsburgh and Erie, December 31, 1911, was as follows: First track, east, 6329.54; west, 5174.22; total, 11,503.76. Second track, east, 2113.36; west, 1479.67; total, 3593.03. Third track, east, 579.57; west, 218.84; total, 798.41. Fourth track, east, 498.10; west, 120.93; total, 619.03. Company's sidings, east, 5090.59; west, 3631.68; total, 8722.27. Total trackage east of Pittsburgh and Erie, 14,611.16; total trackage west of Pittsburgh and Erie, 10,625.34. Grand total of trackage, 25,236.50 miles.

The expenditures on road and equipment of the Pennsylvania Railroad Company during the year 1911 consisted of the following:

Additional property for enlargement and improvement of the freight station facilities at Norristown, Lancaster, Harrisburg, and Uniontown, and for the abolition of grade crossings.

Right of way for small branch lines in the bituminous coal regions.

Awards under right of way condemnation proceedings on the Darby Creek Low Grade Line between Philadelphia and Paoli, and purchase of additional right of way between Colonia and Waverly, N. J., the eastern section of the relief line between Morrisville, Pa., and Newark, N. J.

Considerable progress was made in the rebuilding of the Cortlandt Street Ferry, New York City, which will probably be completed in 1912.

The new four-track elevated line and passenger station at Bristol, Pa., were completed and put in service, and all main-line grade crossings in that city eliminated.

The Newark Rapid Transit Line, which provides a frequent multiple unit electric service to and from the Hudson Terminal, Cortlandt and Church streets, New York, via Manhattan Transfer Station to Park Place, Newark, N. J., was completed and placed in operation November 26, 1911.

The construction of the eastern section of the six-track system between Morrisville, Pa., and Newark, N. J., was undertaken.

Grade crossings at Coatesville, Christiana, Jeannette, Trafford, and at Lambert Street, Pittsburgh, were abolished by the construction of undergrade bridges.

A new freight transfer station was constructed at Harrisburg for the purpose of facilitating the movement of merchandise freight and increasing carloading.

Considerable extensions to the various car shops and additions to the tools and machinery were made.

Improvements at Greensburg, including a new passenger station and the revision of grade and completion of the four-track system, practically completed.

The change of grade and extension of the track facilities in West Brownsville Yard, to reach the elevation of the new double-track Monongahela River bridge at that point, were begun. Contracts have been awarded for the construction of the bridge, to replace the present single-track bridge.

The Northumberland Classification Yard was completed.

The construction of a 16-span, double-track steel bridge over the west branch of the Susquehanna River at Montgomery was authorized and begun.

The aggregate expenditures made by the company for construction and equipment during the year on its owned lines and those of the Harrisburg, Portsmouth, Mt. Joy and Lancaster Railroad Company and United New Jersey Railroad and Canal Company, operated under long-term leases, comprising the main line system between New York and Pittsburgh (including $599,363.01 on account of water supply trust certificates), were $14,319,530.65.

During the year 1912, in addition to that carried over from last year, work will be started on a new grain elevator, with a capacity of 1,000,000 bushels at Girard Point in the Port of Philadelphia, and concrete bridges will be constructed over the Bush and Gunpowder Rivers, on the Maryland Division, near Baltimore, Md.

Philadelphia and Reading Railway Company

THE discovery of anthracite in Schuylkill County, Pa., late in the eighteenth century and the subsequent rapid development of a market therefor was the beginning of the present system of railroads which has become popularly known as "The Reading."

The Schuylkill Canal, which was commenced in 1815 and completed to Mount Carbon in 1825, carried to market an ever-increasing amount of anthracite mined in Schuylkill County in the vicinity of the Schuylkill River. With the discovery of better and more extensive veins at some distance from the canal, it became necessary to devise means for transporting the anthracite to the canal. In the few years between 1827 and 1833 a number of companies were incorporated to build railroads from the canal to the mines, among them being the Mount Carbon Railroad Company, the Little Schuylkill Navigation, Railroad and Coal Company, the Schuylkill Valley Navigation and Railroad Company, the Mount Carbon and Port Carbon Railroad Company, the Mill Creek and Mine Hill Navigation and Railroad Company, and the Mine Hill and Schuylkill Haven Railroad Company.

The Little Schuylkill Navigation, Railroad and Coal Company was chartered not only to build a railroad from the mines near Tamaqua down to the canal at Port Clinton, but was also empowered to continue its line to the Borough of Reading. A number of the gentlemen interested in the construction of the Little Schuylkill Navigation, Railroad and Coal Company conceived the idea of building a railroad from Philadelphia to Reading, to connect there with the Little Schuylkill Railroad, in order that anthracite and other products could be transported during the winter season when the canal was closed to traffic. Accordingly, a bill was presented to the Legislature of Pennsylvania during the session of 1833 by Elijah F. Pennypacker, representative from Chester County, incorporating The Philadelphia and Reading Railroad Company, which was authorized to build a railroad from Port Richmond, on the Delaware River, north of the city of Philadelphia, to a connection with the Little Schuylkill Railroad in the Borough of Reading. The act of incorporation was approved by Governor George Wolf on April 4, 1833.

The stockholders of The Philadelphia and Reading Railroad Company assembled on November 22, 1834, and elected Elihu Chauncey as its first president. The Little Schuylkill Navigation, Railroad and Coal Company, being unable to provide the necessary funds to construct its railroad between Port Clinton and Reading, by an act of the Legislature approved March 31, 1837, The Philadelphia and Reading Railroad Com-

PHILADELPHIA AND READING RAILWAY COMPANY'S TERMINAL, PORT RICHMOND, PHILADELPHIA

pany was given the right to extend its railroad from Reading to Mount Carbon, using the route between Reading and Port Clinton previously granted to the Little Schuylkill Railroad Company, which had consented to the relinquishment of its right thereto.

The Philadelphia and Reading Railroad was opened to regular passenger service between Reading and Pottstown on Tuesday, May 1, 1838; between Pottstown and Norristown (Bridgeport) on July 16, 1838; between Norristown and Philadelphia on December 9, 1839, and between Mount Carbon and Reading on January 13, 1842. The railroad was then 95 miles in length.

William F. Emlen was elected president of The Philadelphia and Reading Railroad Company on January 10, 1842, to succeed Elihu Chauncey, who declined a re-election. Mr. Emlen served only until January 9, 1843, when he was succeeded by John Cryder. During Mr. Cryder's administration the railroad was double-tracked between Philadelphia and Mount Carbon. Mr. Cryder was succeeded as president by John Tucker, who directed the affairs of the company until November 5, 1856, when Robert D. Cullen, who represented the foreign stockholders, was sent from London to succeed him. On January 1, 1851, The Phila-

delphia and Reading Railroad Company purchased from the Canal Commissioners of Pennsylvania that portion of the old Philadelphia and Columbia Railroad, about three miles in length, extending between Belmont and Broad and Vine streets, Philadelphia, including the Columbia Bridge over the Schuylkill River. During Mr. Tucker's term of office, or in the year 1853, The Philadelphia and Reading Railroad Company also

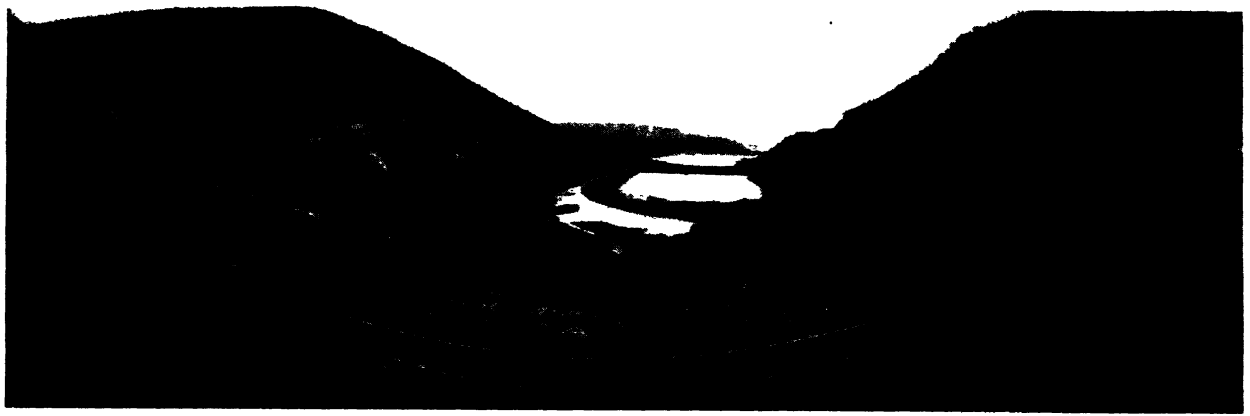
EXPORT PIER G, PORT RICHMOND, PHILADELPHIA, PHILADELPHIA AND READING RAILWAY

acquired the Lebanon Valley Railroad, extending from Reading to Harrisburg, which was then under construction.

In the year 1859 The Philadelphia and Reading Railroad Company began to expand its system by acquiring, either by purchase or through lease, the Philadelphia and Chester Valley Railroad, the Mount Carbon and Port Carbon Railroad, the Schuylkill and Susquehanna Railroad, and the Allentown Railroad.

Robert D. Cullen retired as president of The Philadelphia and Reading Railroad Company on January 9, 1860, and was succeeded by Asa Whitney, a Philadelphia manufacturer. Mr. Whitney resigned from office on July 15, 1861, and Charles E. Smith, an iron manufacturer, suc-

CENTENNIAL CELEBRATION OF STEAMBOAT NAVIGATION ON INLAND WATERS, PITTSBURGH, OCTOBER 31, 1911



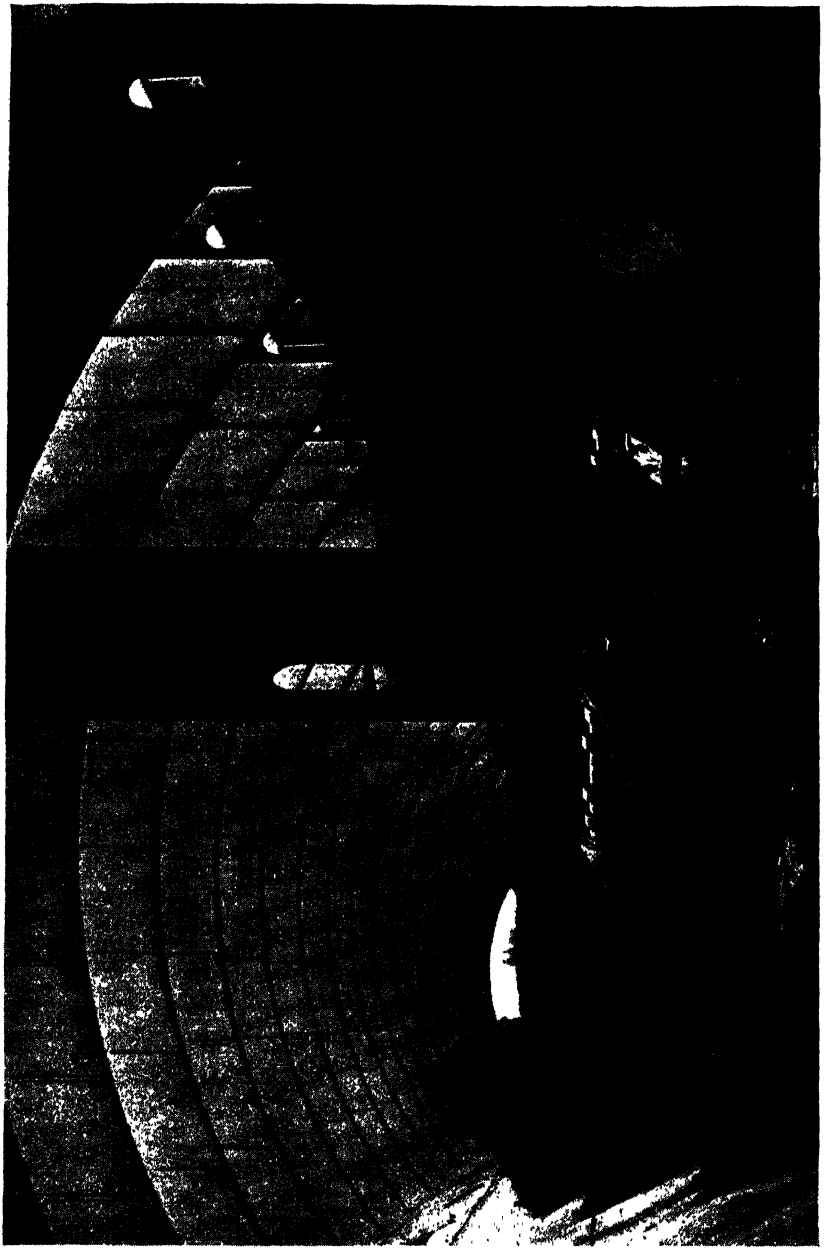
"HORSESHOE CURVE," CROSSING THE ALLEGHENY MOUNTAINS, PENNSYLVANIA RAILROAD

ceeded him. During Mr. Smith's administration the Reading system was further extended by the leasing of the Mill Creek and Mine Hill Navigation and Railroad, the Mahanoy and Broad Mountain Railroad, the Mine Hill and Schuylkill Haven Railroad, the East Mahanoy Railroad, East Pennsylvania Railroad, and the Little Schuylkill Navigation and Railroad, together with the purchase of a controlling interest in the Union Railroad, the Swatara Railroad, the Good Spring Railroad, the Lorberry Creek Railroad, the West Reading Railroad, the Port Kennedy Railroad, the Reading and Columbia Railroad, and the Locust Gap Railroad, most of which railroads were located in the anthracite region of Pennsylvania.

Charles E. Smith, whose administration covered practically the entire civil-war period, retired on April 28, 1869, on account of ill health, and was succeeded by his nominee, Franklin B. Gowen. During Mr. Smith's administration the stock of The Philadelphia and Reading Railroad Company sold in Philadelphia on April 7, 1864, at the highest price it ever reached—namely, $82⅝ per share.

With the advent of Mr. Gowen came a period of greater expansion for the company. In order to secure and hold the anthracite tonnage, upon which the life of The Philadelphia and Reading Railroad Company at that time depended, Mr. Gowen conceived the idea of acquiring sufficient of the anthracite lands to accomplish this purpose. This step was necessary, for the railroad companies having their outlets at New York tidewater were fast encroaching upon the territory served by The Philadelphia and Reading Railroad. These companies had already absorbed practically all the available anthracite fields in the Lehigh and Wyoming regions, and were endeavoring to establish themselves in the Schuylkill region. In order to carry out his plans Mr. Gowen succeeded in having the Laurel Run Improvement Company incorporated on May 18, 1871, to purchase and hold the coal lands as they were acquired from time to time. The name of that company was changed on December 12, 1871, to The Philadelphia and Reading Coal and Iron Company. In 1912 The Philadelphia and Reading Coal and Iron Company owned a total of 171,386 acres of land in the Schuylkill anthracite region, of which 97,642 acres were known to be underlaid with anthracite coal. It was at first intended that the coal in the lands owned by The Philadelphia and Reading Coal and Iron Company should be worked by individuals, but this arrangement proved so unsatisfactory to all concerned that the coal and iron company was finally forced to operate the properties itself.

Such a tremendous amount of money had been invested in the pur-



UNLOADING ORE FROM HOLD OF STEAMER AT LAKE ERIE. SIX ELECTRIC CRANES. THREE TONS TO EACH BUCKET PER LIFT

chase of the coal lands, from which no immediate adequate return was received, that The Philadelphia and Reading Railroad Company and The Philadelphia and Reading Coal and Iron Company were forced into a receivership on May 24, 1880.

At the annual election of The Philadelphia and Reading Railroad Company, held on March 14, 1881, Franklin B. Gowen was defeated for re-election by Frank S. Bond, who was supported by the foreign stockholders, but at the annual election on January 14, 1882, Mr. Gowen again became president of the company. Mr. Gowen declined a re-election on January 14, 1884, but voted, in favor of his nominee, George de B. Keim, the proxies of the stockholders that controlled the meeting. On January 11, 1886, Mr. Gowen again became president of the company, and devoted his time almost entirely to the preparation of a plan of reorganization. He retired on September 22, 1886.

During Mr. Gowen's administration the Philadelphia, Germantown and Norristown Railroad, the Schuylkill Navigation, the Delaware and Bound Brook Railroad, the Catawissa Railroad, the North Pennsylvania Railroad, and the Atlantic City Railroad were taken into the Reading system, either by lease or through stock ownership.

Under the receivership begun on May 24, 1880, the property was restored to the company on February 28, 1883. Scarcely had the receivership of 1880 been concluded before a second receivership was begun on June 2, 1884. Under this second receivership the property was restored to the company on January 2, 1888, and the receivers discharged December 14, 1888.

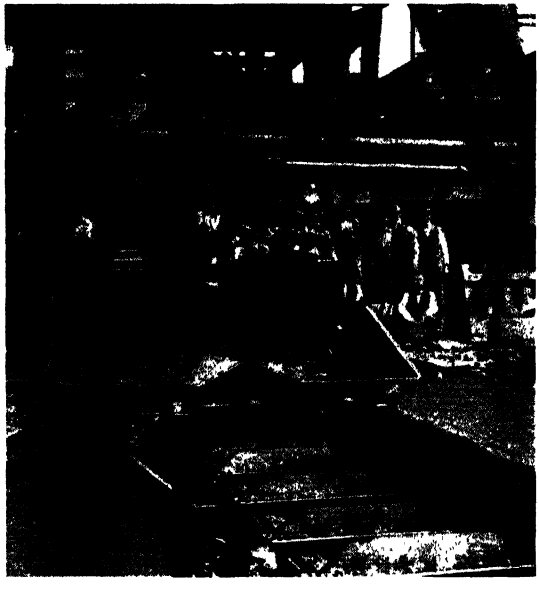
The policy adopted by Mr. Gowen in his management of The Philadelphia and Reading Railroad Company had affected its financial situation to such an extent that the credit of the whole system was entirely dependent upon the success or failure of this policy.

From the viewpoint of the security-holders and stockholders of The Philadelphia and Reading Railroad Company, who were deprived of income and dividends, and whose securities sold at very low prices for many years, and who were obliged to pay assessments, the Reading enterprise, as projected by Mr. Gowen, did not succeed; but, viewed as an enterprise *per se,* a different conclusion may be reached when it is stated that in all the financial difficulties through which the property passed, embracing several reorganizations, and, finally, foreclosure proceedings which destroyed the original charter of the company, all of the property that Mr. Gowen brought together, including the various leases

and acquisitions by which the railroad lines were extended and terminals were obtained, and all of the coal lands originally acquired, has been kept intact.

During the incumbency of both Mr. Bond and Mr. Keim the property was in the hands of receivers.

Austin Corbin was elected president of The Philadelphia and Reading

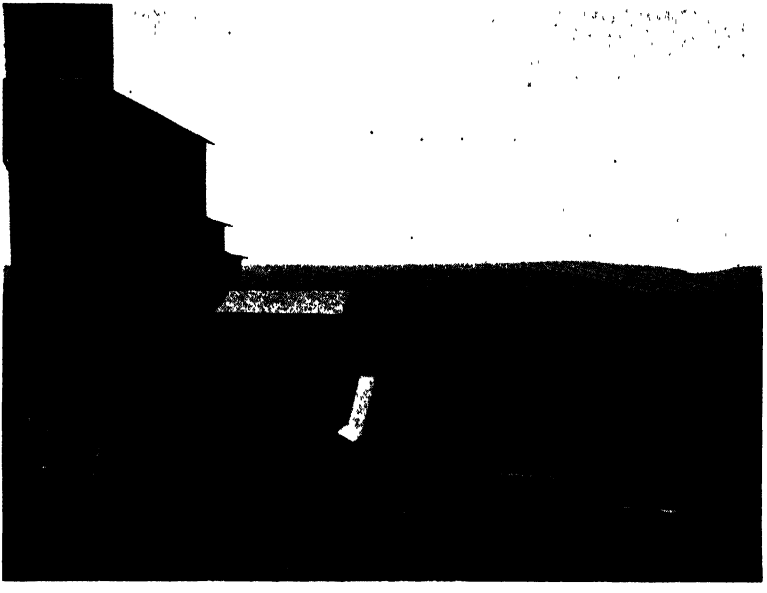


COAL TIPPLE AT HEAD OF SHAFT, ANTHRACITE COAL BREAKER

Railroad Company on September 22, 1886, but as the property was still in the hands of receivers, his labors consisted mainly in assisting in the work of rehabilitating the finances of the company. Mr. Corbin retired on June 27, 1890, and was succeeded by A. A. McLeod as president.

Mr. McLeod entered upon a policy of expansion of the company into new territory. He obtained leases of the Lehigh Valley Railroad and the Central Railroad of New Jersey, and acquired a controlling interest in the Boston and Maine Railroad and the New York and New England Railroad, but the resources of the Reading system were not

sufficient to finance his plans for the consolidation of the various lines under his control into one vast system. While the net earnings of the company after the receivership ended, in 1888, had grown, yet they were not sufficient to enable the company, without danger, to pay the interest upon the preferred income bonds which had been issued under the reorganization; and the attempt to pay this interest and the obligations



ANTHRACITE COAL BREAKER AND MOUNTAIN OF CULM, PLYMOUTH, PA.

assumed under the leases of the Lehigh Valley Railroad and the Central Railroad of New Jersey so reduced the company's resources that it became necessary on February 20, 1893, to have receivers again appointed.

Mr. McLeod was succeeded as president of The Philadelphia and Reading Railroad Company on May 1, 1893, by Joseph S. Harris. Mr. Harris was chosen for this position because of his wide experience in the management of railroad and coal properties, and his conservative management of the Reading properties during the many years they were under his charge amply justified the wisdom of his selection. The property was in bad physical condition, the equipment inadequate, and the company bankrupt, and for nearly four years Mr. Harris and his colleagues toiled to bring the company out of its chaotic condition without

resorting to a sheriff's sale. Finally, it became apparent that the only hope for the salvation and reconstruction of the property lay in a complete and vigorous reorganization, which included the raising of sufficient new capital by the junior security-holders to pay off the pressing obligations of the company. This could only be accomplished through a sale of the property under foreclosure of the general mortgage. A comprehensive plan of reorganization, dated December 14, 1895, was formulated and carried into effect, and on September 23, 1896, the property of The Philadelphia and Reading Railroad Company was sold by the sheriff. The property was purchased by Messrs. Charles H. Coster and Francis Lynde Stetson, who immediately transferred the railroad to a new company that had been organized for the purpose, called the Philadelphia and Reading Railway Company. All the other property and assets of The Philadelphia and Reading Railroad Company were transferred to Reading Company, a proprietary company, which also became owner of the stock of The Philadelphia and Reading Coal and Iron Company and of the stock of the newly organized Philadelphia and Reading Railway Company. The rehabilitation of the property of the Reading system was begun immediately and continued until to-day it is placed among the best-equipped and most carefully managed railroad properties of the country.

Mr. Harris retired from the presidency of the Philadelphia and Reading Railway Company on April 3, 1901, to be succeeded by George F. Baer, the present incumbent.

The following statement well illustrates the tremendous strides that have been taken by the Philadelphia and Reading Railway Company during the period from 1843, the first complete year of operation of the railroad, to June 30, 1911:

Year	Gross Receipts	Anthracite Tonnage	Merchandise Tonnage	Length of Railroad
1843.....	$394,318	218,711	17,534	95
1850.....	2,363,958	1,351,507	63,625	95
1860.....	3,312,546	1,878,156	423,523	152
1870.....	9,571,367	3,311,009	1,754,943	392
1880.....	16,938,885	6,891,341	5,144,044	540
1890.....	20,934,487	8,333,218	9,666,827	670
1900.....	26,902,987	10,672,556	14,192,019	1,000
1910.....	45,428,083	10,929,612	23,260,452	1,022
1911.....	45,663,660	11,675,405	22,284,179	1,014[1]

The Philadelphia and Reading Railway Company had in service on June 30, 1911, the following equipment: 1026 locomotives, 852 passenger

[1] In addition to this mileage, Reading Company, the proprietary company, controlled 1127 additional miles of railroad, thus making the length of railroads in 1911 in the Reading system 2141 miles.

and baggage coaches, 41,912 freight cars, 938 cars in company's service, and a fleet of 128 vessels.

Among a number of important improvements made by the Philadelphia and Reading Railway Company during the past few years, the elevation of the tracks of the company on Ninth Street and on the Richmond branch, Philadelphia, may be considered the most important. Many

READING IRON WORKS, READING, PA.

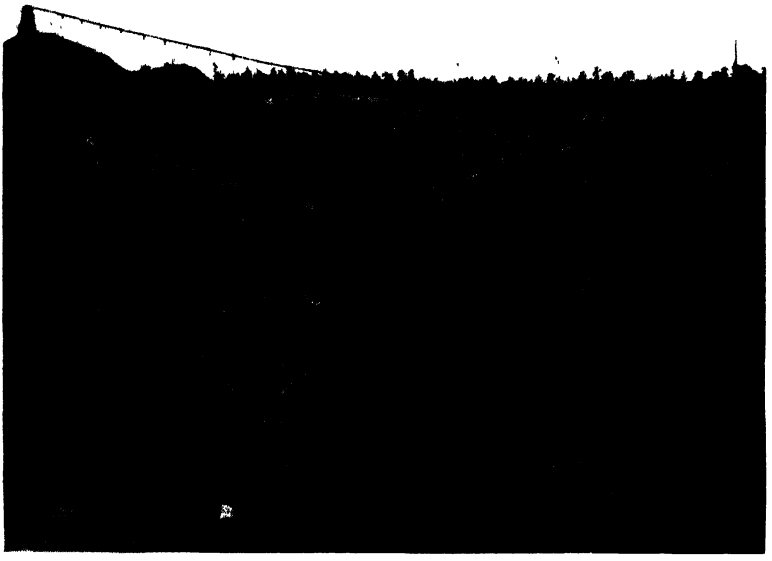
millions of dollars are being spent in this work, and the elevation of the tracks on the Ninth Street section of the work has been completed without interruption to the passage of the nearly four hundred passenger trains and a large number of shifting engines with empty cars or with freight trains, which used that stretch of track daily.

The Philadelphia and Reading Railway Company operates at Port Richmond, Philadelphia, the most extensive shipping terminal in the world conducted under the ownership of any one railroad or transportation system. The shipping terminal covers an area of about 156 acres, and the railroad tracks thereon have a storage capacity for about 4000 cars without congesting or interfering in any way with the movement of traffic on the main or working tracks.

There were shipped from the Port Richmond Coal Piers during the calendar year 1911, 1,931,190 tons of anthracite coal, 2,448,069 tons of bituminous coal, and 1442 tons of coke.

There were handled over Export Piers A, C, and D and Freight Piers G, H, and J during the calendar year 1911, 758,089 tons of export package freight and miscellaneous freight, with a total of 2,970,753 tons of merchandise and iron ore handled during that period, inbound and outbound.

Operating from Port Richmond is a harbor fleet consisting of four



VIEW OF THE "STRIPPING" OF AN ANTHRACITE COAL MINE

steam tugs and thirty-two car-floats. Each car-float has a capacity for eight 8-wheel cars, with an aggregate freight transfer capacity of 400 tons each trip. This fleet is engaged in the movement of freight between the various wharves of the company located on both sides of the Delaware River in the Philadelphia harbor. During the year ended December 31, 1911, this fleet transported 98,417 loaded 8-wheel cars having an aggregate tonnage of 2,490,950 tons.

In addition to this harbor fleet, the Philadelphia and Reading Railway Company, under the trade name of the Philadelphia and Reading Transportation Line, operates from Port Richmond eleven sea-going tugs of from 400 to 644 gross registered tons, with 1000 individual horsepower each, together with sixty-three sea-going schooner barges of the average

carrying capacity of 1508 tons each. During the calendar year 1911 this fleet transported 1,711,886 tons of anthracite and bituminous coal from Port Richmond to ports in New England. One additional tug and ten additional barges are under construction, and will be added to the fleet upon their completion. The fleet will then have a maximum annual carrying capacity of about 2,600,000 tons of coal or other similar cargoes.

During the year 1911 the Philadelphia and Reading Railway Company completed the erection at Pier 14, Port Richmond, of an extensive power plant and two modern-type electrically operated ore-unloading machines. These machines have a combined discharging capacity of from 250 to 300 tons per hour, according to the character of the mineral and the construction of the vessel from which the ore is being discharged. These were first put in operation on April 7, 1911. Prior to that time the ore was discharged from the vessels by means of steam-hoisting gear, using ordinary ore-discharging tubs of the capacity of about 2000 pounds each. The grab buckets of the electrically operated machinery have a capacity of about 10,000 pounds each lift. Between January 1 and December 31, 1911, 894,509 tons of ore were discharged from vessels at the Port Richmond ore piers and hauled in cars to various steel manufacturing plants in Pennsylvania.

There is also located at Port Richmond a grain elevator having a capacity of 1,500,000 bushels. This elevator is equipped with all modern appliances and facilities for cleaning, drying, and improving the condition of the grain stored therein. It is equipped with a marine leg, having a capacity of 25,000 bushels per day for discharge of vessels alongside the elevator. There are twenty-four individual elevators operated within the main elevator structure, and thirty-six scales, so as to provide maximum handling of all kinds and grades of grain received. Two hundred cars of grain can be unloaded and stored in each day of ten hours, and 600,000 bushels may be loaded into cars or vessels in the same period of time. By means of a Hess grain dryer attached to the main elevator building, 20,000 bushels of grain can be thoroughly and efficiently dried in a day of ten hours. Ample facilities are also provided for mixing and transferring the grain. The mixing is done to give the grain a better grade, thereby increasing its commercial value, while the transferring is done to keep the grain in proper condition and to deliver to the various bins or hatches of a vessel taking on cargoes of grain at the elevator. Eight million, thirty thousand and forty-two bushels of grain were delivered to the elevator in the calendar year 1911 for storage.

In addition to the storage capacity for cars on the yard tracks at the Port Richmond terminal there is also a coal-storage plant located at that point, with a storage capacity of 200,000 tons, and with suitable machinery for handling the same. In addition to the coal-storage plant at Port Richmond, The Philadelphia and Reading Coal and Iron Company has similar plants at several other points, among them being one near Bridgeport, Pa., with a capacity of 480,000 tons; one at Schuylkill Haven, Pa., 325,000 tons; one near Mahanoy City, Pa., 200,000 tons; Superior, Wis., 400,000 tons; New Bedford, Mass., 120,000 tons; Chicago, Ill., 160,000 tons; Milwaukee, Wis., 170,000 tons.

During Mr. Baer's administration the Reading system has become so prosperous that dividends are being regularly paid, although the stockholders had to wait for more than a quarter of a century for this condition to be realized. Great prosperity has come to the Reading system though the general increase of wealth and industrial activity of the country; new equipment of a value and capacity previously unheard of in the Reading service has been added to the line; new avenues for business have been opened and new connections made that in the olden days of the company had never been dreamed of. This great prosperity of the Reading system is not due solely to the business conditions of the country at large or to natural increase in the business of the company, but in a great measure is due to the master mind of its president, who has displayed such great constructive ability, wisdom, and forethought in the management of the property that the failures of the past have become the successes of the present.

Other Railroad Lines

IN ADDITION to the thousands of miles of track of its two greatest railroad systems, virtually all of the systems whose main interests are in adjacent States reach out into Pennsylvania's territory for tonnage. In the northeastern part of the State is a network of tracks by which the anthracite roads tap their mines. In the western part of the State are numerous lines, a large part of whose tonnage is the iron ore that comes down the Great Lakes intended for Pittsburgh. But every part of the State has ample rail transportation facilities, and every part produces extensive tonnage.

The Lehigh Valley Railroad

The Lehigh Valley Railroad is one of the most important of the anthracite roads of the State. Extending from the harbor of New York on the east, it enters Pennsylvania's territory at Easton, extends northwesterly to the State line, and continues on to Buffalo. Its many feeders reach out in both directions from the main trunk to take the product of the anthracite mines. Touching the Philadelphia and Reading at Bethlehem, it affords to the city of Philadelphia a through line to the Great Lakes.

The Lehigh Valley was chartered April 21, 1846, under the laws of Pennsylvania, as the Delaware, Lehigh, Schuylkill and Susquehanna Railroad Company. Its present title was taken in 1853. In 1864 it absorbed the Beaver Meadow Railroad, the Penn Haven and White Haven Railroad, in 1866 the Lehigh and Mahanoy Railroad, in 1868 the Hazleton Railroad and the Lehigh, Luzerne Railroad. It controls the Lehigh Valley Railroad Company of New Jersey, the Eastern and Northern Railroad, the Schuylkill and Lehigh Valley Railroad, the Delaware, Susquehanna and Schuylkill Railroad, the Pennsylvania and New York Canal and Railroad, and several other minor companies through ownership of their capital stocks, and has control of still other properties by lease. An important part of its controlled property is the Lehigh Valley Coal Company, and it has also the Morris Canal and Banking Company. In 1892 the Lehigh Valley property was leased to the Phila-

STEAMERS AWAITING PASSAGE THROUGH THE LOCKS, ST. MARY'S FALLS CANAL

delphia and Reading Railroad Company, but on August 8, 1893, this lease was abrogated and the property reverted to the Lehigh.

The mileage of the system, including owned lines or lines controlled by ownership of entire capital stock, is 1242 miles. Its main line from Phillipsburg, N. J., to Wilkes-Barre, Pa., is 99 miles, and the distance from Wilkes-Barre to the State line is 96 miles, so that in traversing the northeastern section of the State the main stem of the railroad covers a distance of 195 miles. The distance covered between Pennsylvania State line and Buffalo, which carries the system to the traffic of the Great Lakes, is 175 miles.

The total amount of rolling stock owned by the company, 1910, was 45,317, of which 874 were locomotives. The freight cars numbered 44,158, by which it will be seen how small is the ratio of passenger business to the profitable freight traffic of the road. The total receipts, 1910, were $36,167,398, and the net income $15,600,886, which was the largest in the history of the property. The following statement shows at a glance the mileage, equipment and general balances of the Lehigh Valley Railroad Company for the three years ending 1910:

	1908	1909	1910
Miles of road operated	1,445	1,441	1,433
Miles of track	3,228	3,241	3,261
Miles of steel rail	3,228	3,241	3,261
Locomotives	885	873	874
Cars	44,221	43,734	45,317
Capital stock	$40,441,100	$40,441,100	$40,441,100
Total assets	$158,010,851	$157,714,594	$160,928,250

Through its ownership of the entire capital stock of the Lehigh Valley Coal Company and other minor interests, the Lehigh Valley is the owner of valuable coal properties in the anthracite region, none of which, however, are directly operated by the railroad. Its profits derived from this ownership are through dividends paid by the respective coal companies. The company owns bonds, certificates of indebtedness, and stocks in railroad, coal, transportation, grain elevator, and miscellaneous companies of a total par value of $74,832,422.

Delaware, Lackawanna and Western

Ranking next in importance in so far as interests within the State of Pennsylvania are concerned is the Delaware, Lackawanna and Western, which also cuts diagonally across the northeastern section, touching the anthracite territory. It owns the extensive anthracite coal lands in Lacka-

wanna and Luzerne counties. By its charter, granted in 1849 under the laws of Pennsylvania, it is specially empowered to own coal lands, to mine, purchase, transport, and engage in the merchandising of coal. A decision rendered by the United States Supreme Court, making it unlawful for railroad companies to transport in interstate commerce coal owned by themselves, the sales division of the coal department was discontinued in 1909, and there was organized under the laws of New Jersey a coal-selling company, known as the Delaware, Lackawanna and Western Coal Company. Under a contract made with this new company the railroad agreed to sell its coal on board cars at the mines on the same basis as generally prevails in the anthracite region, and also to sell and turn over all stocks of coal along its lines and on western docks, and to lease its trestles to the coal company.

From the Pennsylvania State line at the north, the Delaware, Lackawanna and Western reaches out to the trade of the Great Lakes. Its total length of all lines owned, leased, or controlled December 31, 1910, was 956 miles, and of this the mileage in Pennsylvania was 245. The Pennsylvania part of the system includes the main line for a distance of 113 miles; Bangor and Portland branch, 38 miles; Hanover and Newport branch, 7 miles; Bloomsburg branch, 80 miles, and New York, Lackawanna and Western, of Pennsylvania, 6 miles. The rolling stock includes 770 locomotives, 862 passenger train cars, and 29,408 freight and service cars. The total gross earnings for the year 1910 were $36,052,932. The operations of the coal department showed sales of 9,916,837 tons, the receipts being $21,677,825. The total assets were $81,785,733.

Delaware and Hudson Company

The Delaware and Hudson extends in Pennsylvania from Plymouth northward to the State line. It was originally chartered in 1823 by the New York Legislature to construct a canal from the coal fields of Pennsylvania to the Hudson River at Rondout. The canal under this charter was completed in 1828, and in the following year a gravity railroad was built. The present name was taken in 1829, under act of the Legislature, the company being authorized at the same time to sell the canal. This sale of the canal was effected in 1889, and later the gravity railroad was broadened to a standard gauge steam railroad and opened for passenger and freight business in 1900. On June 1, 1909, a contract was made with the Hudson Coal Company, under which the coal produced from the

mines belonging to the Delaware and Hudson Company is purchased at the mines.

The rolling stock of the company includes 447 locomotives, 475 passenger cars, and 20,857 freight cars. Earnings for the year 1910 amounted to $20,431,800, and the total net earnings of the railroad and coal departments were $8,592,175.

Erie Railroad

The interests of the Erie Railroad in Pennsylvania are also extensive. On June 10, 1901, the company purchased the entire capital stock of the Pennsylvania Coal Company, and the Erie and Wyoming Valley Railroad Company. It is thus to-day one of the important anthracite railroads of Pennsylvania.

Baltimore and Ohio Railroad

The Baltimore and Ohio Railroad cuts through the southwestern corner of the State, connecting the Lakes with Baltimore, Md., through Pittsburgh. Its numerous branch lines are an important part of the transportation facilities of this part of the State.

The Baltimore and Ohio line, connecting Washington, Baltimore, and Philadelphia, affords to the Philadelphia and Reading an outlet to the two former cities, while it affords to the Baltimore and Ohio access, over the Reading line, to New York.

The Ore Roads

Several lines transport the ore of the Lake Superior ranges from the Great Lakes to the Pittsburgh district. The Pittsburgh and Lake Erie, a controlled line of the New York Central system, extends from Pittsburgh to Youngstown, Ohio, where it has a New York Central connection to Ashtabula. This road is operated as an independent system.

The Bessemer and Lake Erie Railroad is the United States Steel connection with the lakes. The line, which extends from Kremis to Osgood, Pa., and which was chartered January 1, 1901, took a 999-year lease of the Pittsburgh, Bessemer and Lake Erie Railroad. The Carnegie Steel Company, an underlying company of the United States Steel Corporation, owns its entire capital stock. The company has 137 locomotives, 45 passenger cars, and 9932 freight cars. Its freight earnings in 1910 were $7,459,482. This road carries the ore of the United States Steel from Conneaut to the Carnegie works at Pittsburgh.

The Cleveland and Pittsburgh Railroad is operated under lease by the Pennsylvania Company. Its main line is from Rochester, Pa., to Cleveland, Ohio, a distance of 123 miles, and it has trackage rights over the Pittsburgh, Fort Wayne and Chicago Railway, another leased line of the Pennsylvania Company, from Rochester to Pittsburgh, a distance of 25 miles.

Pittsburgh also has connection with Buffalo by lines controlled by the Pennsylvania, and with Ashtabula over Baltimore and Ohio lines.

The Buffalo, Rochester and Pittsburgh extends direct south from Buffalo to Du Bois, Pa., where it reaches out to the eastward to Clearfield and Williamsport, and to the westward to Pittsburgh and the great tonnage-producing district of New Castle.

The Intracoastal Canal Chain

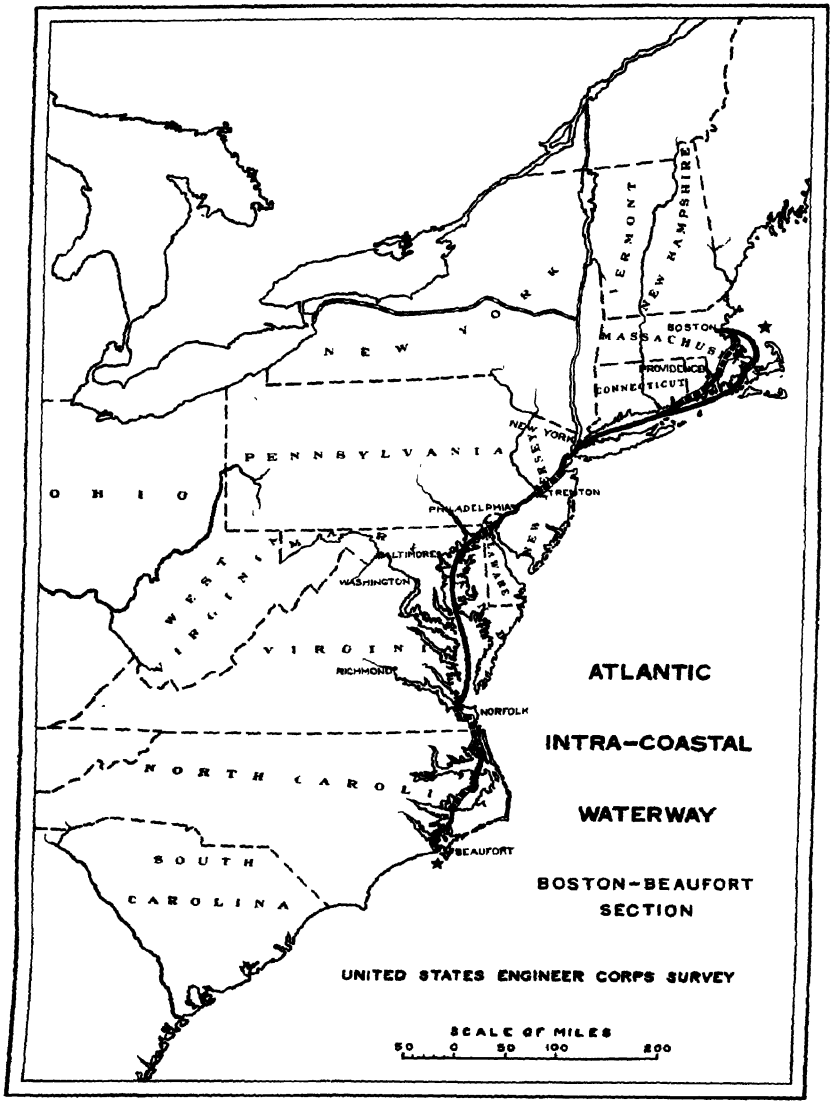
IT IS less than five years since public attention was attracted to the feasibility and necessity of a free intracoastal waterway, to extend from New England on the north to the Carolinas on the south. Yet so powerfully has the public view been focused upon this important question in these few years, that already recommendations looking toward a continuous chain of inland waterways have been made to Congress by the United States Corps of Engineers.

Congestion of freights in the States touching the Atlantic seaboard first suggested the necessity of a barge route, to relieve the railroads of the heavier classes of commodities. The tremendously expanding industrial activity of this seaboard tier of States had at times overtaxed the carrying capacity of the railroads. A second reason for the improvement lay in the peculiarly dangerous character of certain parts of the Atlantic Coast, notably Cape Hatteras. A third arose from the existence, over a large part of the proposed route, of canals of restricted dimensions, capable of passing small barge traffic.

Yet, notwithstanding the fact of this almost continuous inside route, needing only improvement to be available for barges of sufficient size to carry traffic economically, this great opportunity for the expansion of commerce throughout the seaboard States remained neglected until 1907. In that year the Atlantic Deeper Waterways Association was organized in Philadelphia, with the purpose of arousing the cities and States of the East, and the nation at large, to the urgent necessity of the development of a canal chain. Congressman J. Hampton Moore was the active, vitalizing force in the new movement.

The conference which resulted in the formation of the association began its sessions in Philadelphia, November 19, 1907. Mr. Moore was elected president of the association, and is still its active directing head. Four conferences have since been held at Baltimore, Norfolk, Providence, and Richmond, with the result that public interest has steadily increased and that the insistence on an actual beginning of operations has become steadily greater.

Prior to the inception of this movement, which is the more impor-


NEW YORK
VERMONT
NEW HAMPSHIRE
MASSACHUS
BOSTON
PROVIDENCE
CONNECTICUT
NEW YORK
PENNSYLVANIA
OHIO
NEW JERSEY
TRENTON
PHILADELPHIA
BALTIMORE
WASHINGTON
WEST VIRGINIA
VIRGINIA
RICHMOND
NORFOLK
NORTH CAROLINA
BEAUFORT
SOUTH CAROLINA
ATLANTIC
INTRA-COASTAL
WATERWAY
BOSTON-BEAUFORT
SECTION
UNITED STATES ENGINEER CORPS SURVEY
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tant because it marks the beginning of an epoch, efforts somewhat spasmodic in their nature had been made to arouse public sentiment to the importance of modern canalization. Philadelphia, in the nineties, took up the question of the decadence of the Delaware and Raritan Canal, which is the link of the existing chain that extends across the State of New Jersey, from New Brunswick to Bordentown. Private capital had turned its attention seriously to the cutting of an inside waterway across Cape Cod.

Efforts had, from time to time, been made to obtain Government action looking toward the acquirement and deepening of the Chesapeake and Delaware Canal, which, both geographically and tactically, is regarded as the pivot of the proposed waterways chain. The construction of this canal, which connects the Delaware River and Bay with the Chesapeake, was begun in 1824. The route is from Delaware City, on the east, to Chesapeake City, on the west. At this latter point the canal connects with Back Creek and the Elk River, which give access to Chesapeake Bay. Water was run into the canal for the first time in 1829. The distance covered is 13⅝ miles The canal contains three locks, each 220 feet long by 24 feet wide. The cut is 36 feet wide at the bottom, and has a depth of 10 feet. Of the total amount of $2,250,000 raised for its construction, one-fifth was contributed by the United States, $100,000 by the State of Pennsylvania, $50,000 by the State of Maryland, and $25,000 by the State of Delaware. The remainder was contributed by citizens of these three States. It will thus be seen that of the Commonwealths interested in this early canal project, Pennsylvania bore the leading part, and even at that day the importance of this waterway to the commercial interests of the State of Pennsylvania was evidently clearly appreciated.

As early as 1871 a national commercial convention, held in Baltimore, inaugurated a movement for a ship canal to connect the two bays. Surveys were made by the direction of the Secretary of War in 1882. Twelve years later, a river and harbor act authorized the President to appoint a board to determine the most feasible route for the construction of a ship canal.

Congress, by joint resolution, passed in 1906, created a commission to appraise the works and franchises of the Chesapeake and Delaware Canal. The report of this commission, made to the Fifty-ninth Congress, second session, favored the adoption of the present Chesapeake and Delaware Canal route. Though the importance of this undertaking was made clear by the report of the commission, it is quite likely that no

further steps would have been taken for years to come, had it not been for the organization of the Atlantic Deeper Waterways Association and the work of education which in the last five years has been so aggressively prosecuted. As a result of this work, provision was made in the River and Harbor Act of March 3, 1909, authorizing the Secretary of War to cause to be made preliminary examinations and surveys for the entire canal route, from Boston southward.

The intracoastal waterways, as proposed, consist of the following canal routes: Boston, Mass., to Narragansett Bay; Narragansett Bay to Long Island Sound; New York Bay to Delaware River; Delaware River to Chesapeake Bay; Norfolk, Va., to the sounds of North Carolina and Beaufort Inlet. The plans contemplate the extension of these waterways southward and westward from Beaufort to the Rio Grande, and surveys for these were also authorized.

The special board of engineers which was appointed under the provisions of the act of March 3, 1907, to survey the proposed canal route, consisted of Col. William M. Black, Lieut. Col. Edw. Burr, Lieut. Col. James C. Sanford, Maj. Joseph E. Kuhn, and Capt. Lewis H. Rand. The board was directed to perform the work for the division of the waterway from Boston, Mass., to Beaufort Inlet, N. C. Under date of July 13, 1909, Lieut. Col. Mason M. Patrick was substituted for Maj. Joseph E. Kuhn; under date of February 12, 1910, Maj. R. R. Raymond was substituted for Capt. Lewis H. Rand, and under date of May 31, 1910, Col. F. V. Abbot was substituted for Lieut. Col. Edw. Burr, these changes having been necessitated by changes of stations and duties of the officers concerned.

Private enterprise had already begun to make the canal across Cape Cod when this board was appointed. This cut is a short connection of 8 miles through a sandy isthmus, having a maximum elevation of 29 feet above sea level. It extends from Buzzard's Bay to Cape Cod Bay. At the eastern end there has already been constructed a breakwater, which contains more than 400,000 tons of granite, to protect the canal against northeast gales. More than half of the work has been completed, eight large dredges and steam shovels being used. More than 1000 acres of land have been purchased for manufacturing sites, while a railroad is to traverse the entire length of the cut, thus affording land, as well as water, transportation. This cut will enable ships moving southward from Boston to other Atlantic ports to avoid the hazards of outside navigation around the dangerous southeast New England coast. The

The Intracoastal Canal Chain

depth is to be 25 feet, the minimum bottom width 100 feet and minimum surface width 250 feet. The annual tonnage tributary to the canal is estimated at 25,000,000 tons.

The special board of engineers has examined all practicable routes in the New England section, and has surveyed two. Both of these start at Narragansett Bay, one entirely inland from Taunton to Hingham, and the other inland from Taunton to Plymouth, and thence from that point 30 miles via Massachusetts Bay to Boston. It also considered the advisability of the purchase of the partly completed Cape Cod Canal.

Estimates of cost were made, varying from $17,453,000 for a canal 18 feet deep, with bottom width of 125 feet, via Taunton to Plymouth, to $40,047,000 for a canal 25 feet deep, with bottom width of 200 feet, via Taunton to Hingham.

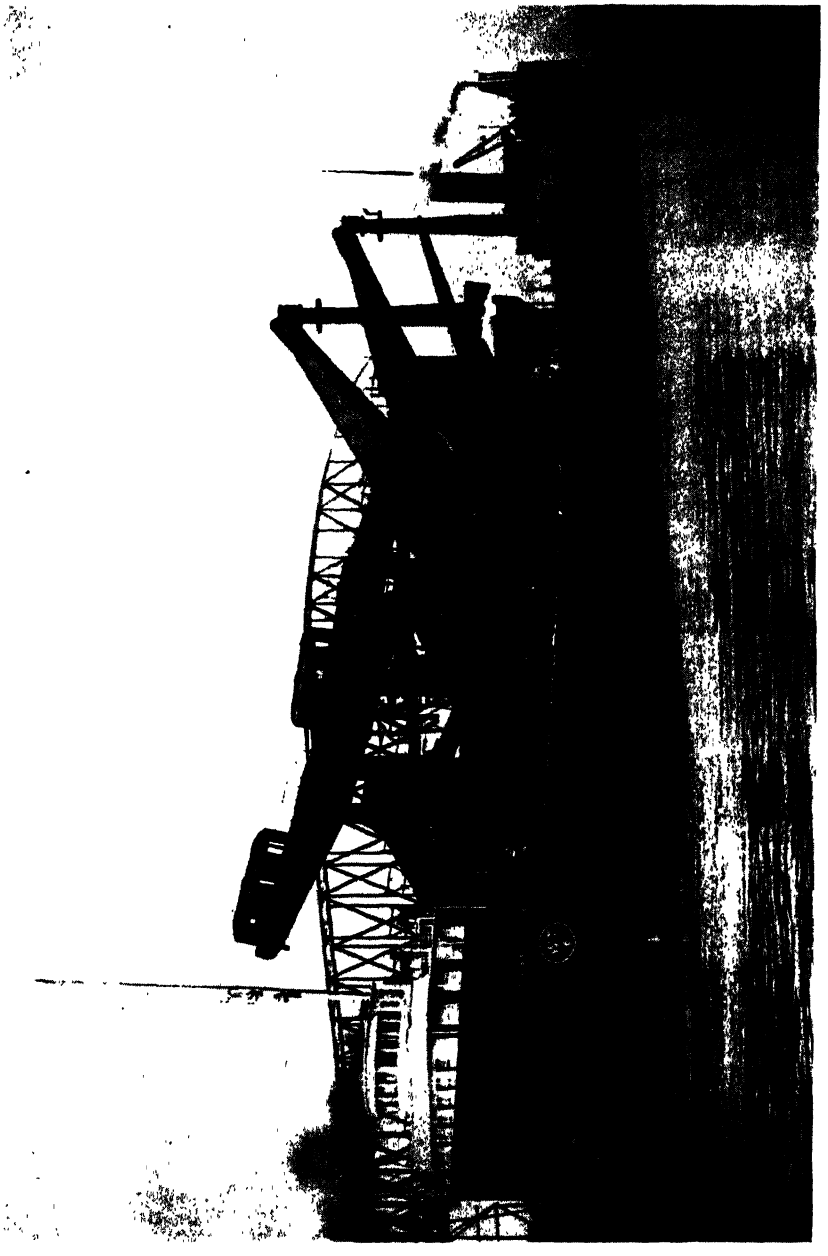
It was the opinion of the board that there appears to be no commercial necessity to justify the construction of a canal over either of these inland routes. It was further the belief that after the measure of relief to commerce to be afforded by the Cape Cod Ship Canal has been demonstrated, the question of a need for a completely sheltered waterway between Narragansett Bay and Boston should receive further consideration. It was not deemed advisable for the Government to enter into negotiations with a view to the acquisition of the Cape Cod Canal.

Examinations and surveys were also made of the Narragansett Bay-Long Island Sound section, of the New York Bay-Delaware River section, of the Delaware River-Chesapeake Bay section, and of the Norfolk-Beaufort section.

As to the Narragansett Bay-Long Island Sound section, it was recommended by the special board that a canal 18 feet deep, with 125 feet bottom width, terminating at Bissell's Cove, be constructed, at an estimated cost of $12,322,000. However, the board of engineers and General Bixby, chief of engineers, failed to concur in this recommendation.

Over the New York Bay-Delaware River section all practicable routes were examined, and the feasible routes surveyed. The board considered the advisability of purchase by the Government of the present Delaware and Raritan Canal, but decided not to recommend that this step be taken.

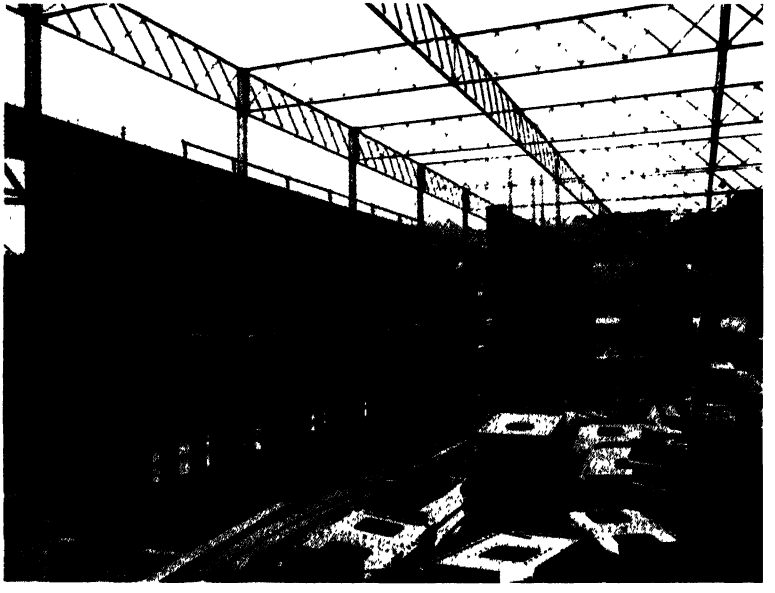
One factor in the problem, so far as this chain in the route is concerned, is the action already taken by the State of New Jersey looking toward a free waterway across the State to connect the waters of New York harbor with the Delaware River. By resolution of the Legislature



ORE STEAMER, WITH ELECTRIC UNLOADING CRANES, ASHTABULA, OHIO

of New Jersey, it has been decided to expend a sum not to exceed $500,000 to provide a right of way for the canal.

In its consideration of this link in the chain, the board proceeded upon the belief that should a canal be built across the State it must be so located as to cause the least possible interference between land and water traffic. It pointed out that a vast amount of railroad traffic passes



LEAF OF THE LOCK GATES FOR THE GATUN LOCKS, PANAMA CANAL, ASSEMBLED AT THE SHOPS OF THE MCCLINTIC-MARSHALL CONSTRUCTION COMPANY. PITTSBURGH IS SUPPLYING 80 PER CENT. OF THE METAL WORK FOR THE PANAMA CANAL

between Philadelphia and New York, and that the use of drawbridges has become virtually impossible. It was, therefore, laid down by the board as a condition, that no trunk-line railroad should be crossed at grade—that should it be necessary to cross a trunk-line railroad, the crossing be made at a point where the railroad could be depressed sufficiently to pass under the canal, or where the railroad could be elevated sufficiently to permit the construction of a fixed bridge with clear height under it sufficient for all classes of shipping using the canal.

The board recommended, however, that the construction of this

section of the canal be deferred until after the construction of the two more southerly sections, and until the United States plant now at work in the Panama Canal shall be made available.

A committee appointed by the Atlantic Deeper Waterways Association, and which strongly advocated the construction of the canal, has predicted that it will at the outset have an annual traffic of 5,250,000 tons, and that this will rapidly increase.

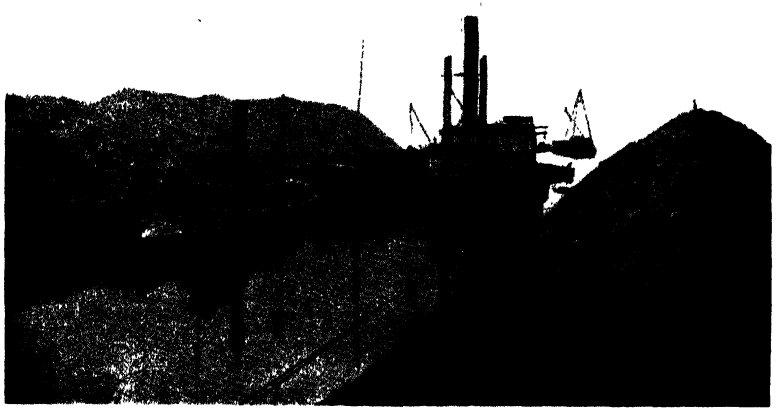
As to the advisability of the immediate acquirement and deepening of the Chesapeake and Delaware Canal, there was a common opinion. The special board selected a route which coincides with the present line of the Chesapeake and Delaware Canal. This is at the narrowest part of the peninsula, where an arm of Chesapeake Bay penetrates to about twelve miles from the Delaware. The board recommends the purchase of the existing canal, at a price not to exceed $2,514,289.70, and the construction of a tide-level canal of 25 feet depth at mean low water. The construction cost will be $9,910,210, making a total initial cost of $12,424,500.

The board gives the following summary of statistics under the plan as prepared:

Length of land cut ..... miles..	13.6
Length of dredged channel in Delaware River.....do....	.9
Length of dredged channel in Back Creek.....do....	4.5
Length of dredged channel in Elk River.....do....	8.5
Length of dredged channel in Chesapeake Bay.....do....	10.0
Distance from Baltimore to entrance to Delaware Bay via Cape Charles .....miles..	320.0
Distance from Baltimore to entrance to Delaware Bay via canal .....miles..	136.0
Saving in distance from Baltimore to common point...do....	184 0
Saving in time from Baltimore to common point.....hours..	16
Depth of canal at lowest low water.....feet..	25
Width of canal at bottom in land section.....do...	125
Width of canal at bottom in Delaware River.....do...	600
Width of canal at bottom in Back Creek.....do...	125
Width of canal at bottom in Elk River.....do...	250
Width of canal at bottom in Chesapeake Bay.....do...	600
Maximum slope in canal banks above water.....	1–2½
Side slope in dredged channel, land cut.....	1–2½
Side slope in dredged channel, Delaware River	1–10
Side slope in dredged channel, Back Creek.....	1–5
Side slope in dredged channel, Elk River.....	1–5
Side slope in dredged channel, Chesapeake Bay.....	1–5
Number of locks	None
Number of highway bridges	6
Number of railway bridges	1
Excavation .....cubic yards..	42,675,595
Estimated cost of construction	$9,910,210.00
Estimated cost of acquiring private waterway.....	$2,514,289.70

In giving his endorsement to the recommendation of the board, General Bixby, Chief of Engineers, makes this comment:

"This canal forms an essential part of a through inland waterway connecting New York and Philadelphia with the South. Its purchase, and the abolishment of tolls, will produce at once a considerable saving in transportation expenses, and should result in an early and substantial



DREDGING THE CAPE COD CANAL

increase of traffic with advantage to the commerce of several States. This canal is at present 10 feet deep, and of the lock type, the locks being 24 feet wide by 220 feet long. The change should be made gradually and in such a way as to interfere as little as possible with existing traffic; and 12 feet depth or thereabout will be secured throughout the canal before the deepening is carried to 25 feet. While the recommendation for immediate purchase of this canal, and the enlargement of this section to about twelve feet, is a definite recommendation, the method of deepening to 25 feet and the rapidity of work for the first and subsequent deepening must depend considerably upon the cost of the intermediate steps, and further estimates for such portions of the work will, therefore, be called for and submitted later with final recommendation for this section."

It is the opinion of the Special Board of Engineers that the annual savings caused by the opening of a free waterway across the Delaware peninsula (this based upon existing traffic) will be $1,414,242. It predicts that the completion of this canal will be followed by a very great traffic, and declares that, independently of any relation that this canal may have to a through intracoastal waterway, its value to existing commerce justifies its construction by the Government. The board further sets forth that according to the reports of the Chesapeake and Delaware Canal Company, the average annual shipments through the canal for the last five years have been 716,644 tons, for which the tolls have averaged $163,151.33, or a general average of 22¾ cents per ton. Applying this general rate to the traffic reported as now existing and ready to use a free canal, it is found that a free canal would produce a saving on tolls not less than $577,309 per year. In addition to the saving on tolls, a further saving of 21¾ cents per ton on the general run of freight is estimated as probable.

The saving in freight costs which may naturally be expected to follow the opening of this canal to free and unrestricted commerce may be judged from the following comparative rail and barge rates prepared by shipping experts:

Commodity	Origin and Destination	Barge Rate[1]	Equivalent Railroad Rate	Actual Railroad Rate
Lumber	Norfolk to Philadelphia.	$2 per thousand feet.	$3.15 per thousand feet.	$1.80 per 2000 pounds.
Sand	Philadelphia to New York.	85 cents to $1 per ton.	$1.60 per ton..	$1.60 per 2000 pounds.
Railroad ties ..	Norfolk to Philadelphia.	11 to 12 cents per tie.	15¾ cents per tie.	9 cents per 100 pounds.
Pig iron	do	95 cents to $1 per ton.	$1.95 per ton..	$1.95 per 2240 pounds.
Pulp wood ..	do	$1.80 per cord.	$3.85 per cord.	$2.20 per 2000 pounds.
Fertilizer .. .	Philadelphia to Norfolk.	$1 to $1.25 per ton.	$1.60 per ton..	$1.60 per 2000 pounds.
Coke	Philadelphia to Baltimore.	60 cents per ton.	$1.20 per ton..	$1.20 per 2000 pounds.
Cinders	Philadelphia to New York.	85 cents to $1 per ton.	$1.90 per ton..	$1.90 per 2000 pounds.
Clay	do	do	$1.85 per ton..	$1.85 per ton.
Coal anthracite[2]	Philadelphia to Boston.	65 to 75 cents per ton.	$2.65 per ton..	$2.65 per ton.
Do.[2]	Philadelphia to Providence.	55 to 60 cents per ton.	$2.70 per ton..	$2.70 per ton.

[1] Barge rates between Philadelphia and eastern points via outside route; between Philadelphia and southern points via inside route.

[2] Railroad coal rate from Shamokin, Schuylkill district.

The southernmost links of the waterways chain examined by the board were the Albemarle and Chesapeake Canal, and that south from Albemarle Sound to Pamlico Sound and Beaufort Inlet. The board recommends that the property of the Albemarle and Chesapeake Canal Company be purchased by the United States at an estimated cost of $500,000. It is recommended that a waterway 12 feet deep be constructed between Norfolk, Va., and Beaufort Inlet, N. C., at an estimated cost of $5,400,000.

The Rivers and Harbors Bill reported to Congress, in March, 1912, gave the first substantial recognition to the United States Army Engineers' report, by providing that the Chesapeake and Albemarle Canal, leading from the North Carolina Sounds to Hampton Roads and the Chesapeake Bay, be taken over and made free.

What was really the first link was completed, prior to the recent surveys, by the dredging of the Beaufort cut, which connects the Carolina Sounds, at Beaufort, N. C., with the ocean below Cape Hatteras. This is 10 feet deep, and is developing a large tonnage. The Chesapeake and Albemarle Canal is to be next, and, working northward, the next logical step is the Chesapeake and Delaware Canal.

The Ohio and Its Tributaries

THE improvement of the Ohio River is to obtain a 9-foot navigable depth from Pittsburgh, Pa., to Cairo, Ill., at the confluence of the Ohio with the Mississippi. Between Pittsburgh and the Ohio line, a distance of 40 miles, there is a series of seven dams, while between Pittsburgh and Cairo, a distance of 967 miles, there will be fifty-four dams. There have been finished thirteen of the number, and nine additional are under contract. Including what has been done and what is to be done, the cost will be approximately $69,000,000.

While the enormous coal tonnage of Pittsburgh was the primary consideration at the outset in this undertaking, it was recognized that with the river at its former stage there had been no opportunity for the full development of tonnage. It was the belief that with a navigation sufficiently comprehensive to permit the expansion of water-carried tonnage in the Ohio Valley, there would develop local and through traffic that would speedily bring the Pittsburgh coal tonnage down to a small percentage of the total amount. When it is considered that of the tributaries of the Ohio there are more than one thousand miles of navigable waterway improved by locks and dams, it will be seen how great is the opportunity for tonnage development when the Ohio improvement shall be completed. The improvement has not as yet, however, reached a stage where large expansion of tonnage can be expected; nor will the full benefit to commerce be reaped until there is slack-water navigation from Pittsburgh to Louisville, which will require at least six years longer.

The Ohio in its original condition had a low-water channel depth varying from 1 foot at Pittsburgh to 2 feet at the Ohio State line, the average slope being about 1.25 feet per mile and the minimum discharge at the head about 1600 cubic feet per second. The greatest measured discharge at Pittsburgh was 439,565 cubic feet per second on March 15, 1907. Under the original project for open-river improvement, work was conducted on this portion of the river at a number of shoals.

Under the original project for lock and dam construction, adopted in 1875, Dam No. 1 was begun in 1877 and completed in 1885 at a cost of

$940,833.31, and the drift gap was begun in 1888 and completed in 1889 at a cost of $32,857.56, making the total cost of completing the lock and dam $973,690.87. Appropriations and allotments aggregating $970,034.01 have been made and $3,655.86 was realized from other sources.

The present project, in its original form, was adopted by Congress September 19, 1890. The plan of improvement is designed to afford facilities for passing the maximum tonnage with the least possible delay. The traffic moves down the Ohio from Pittsburgh in large fleets. Barges of 1000-tons capacity are used, and in certain stages the river will carry these without the aid of dams and slack-water navigation. At such stages lockage is unnecessary, and by using the normal depth, lockage is avoided and the traffic may be moved in larger fleets. It has become, therefore, in the improvement of the river, a problem of using the river channel and avoiding the necessity of lockage so far as possible. For this reason the series of dams between Pittsburgh and Cairo are of the movable type, permitting the traffic to use the channel when the natural depth is great, and affording slack-water navigation when the river is low.

The number of boats in the coal fleets as they leave Pittsburgh is as high as twenty-four, and this is increased in number as they proceed down the river. An idea of their size when they reach the Mississippi is given by the statement that the steamer "Sprague" passed Memphis on May 17, 1904, towing fifty-six coal-boats, containing 1,400,000 bushels—56,000 tons. This record-making fleet was 1132 feet in length by 312 feet in width.

In the recent construction of movable dams, the engineers have favored the "bear-trap." This type was invented in the United States in 1818. French engineers who made a trial of it declared it to be a failure. The early method of construction, however, was, of course, radically different from that now practiced in the Ohio River work.

In 1901 two steel dams of the "bear-trap" type were built on the Allegheny, and their success led to their adoption for the Ohio. These were of the usual form—two broad leaves of steel, hinged at the bottom, and lapping over each other. These "bear-traps" are used as an automatic weir, forming a section of the river dam.

One reason that has influenced the engineers in adopting this type is that all other forms that are practicable for movable dams of considerable height must be mechanically raised or lowered, while with this, the operation of valves is all that is needed. It has been found that a dam 120 feet long of the construction adopted may be lowered in one minute

and raised in three or four minutes. The largest thus far built are at Dam No. 6 in the Ohio. They are 120 feet long and 13 feet high. These are of steel construction, the lower leaf entirely of steel, and the upper of steel with wood sheathing.

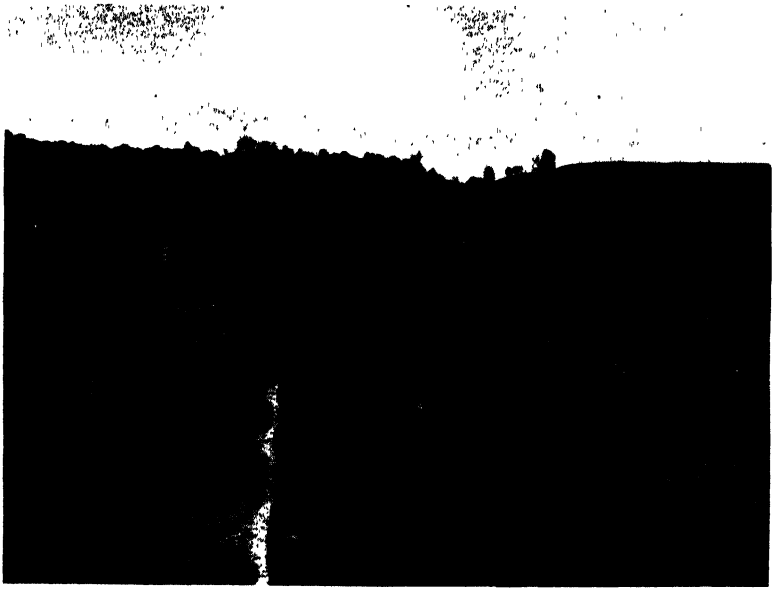
In conjunction with the "bear-trap," the Chanoine wicket is being used as a main dam. For the head of the falls at Louisville, a Boulé

LOCKAGE OF COAL, LOCK NO. 2, OHIO RIVER

dam has been adopted. It is the belief of the engineers in charge of the work that the "bear-trap" is valuable for pool regulation purposes in a movable dam system where rises are rapid. The belief is expressed, however, that: "One thing stands inevitably in the way of the general use of 'bear-trap' gates for navigation purposes. They cannot be introduced in long sections, such as for navigable passes or for shorter dams over their entire length, because of their rapid movement both upward and downward, which in the first instance would cause a too sudden reduction in the river's discharge, and in the latter case would create an immense wave, destructive alike to everything afloat, both above and below it. As an automatic weir for pool regulation and rise control, however, it has no equal, and its popularity for such use will undoubtedly

continue unless a better device is discovered. It is probable that in future constructions, traps of varying width will be introduced, thus affording greater flexibility to the system and more readily accommodating the operations to the varying conditions of the water."

When the river is below nine feet the dams are raised and kept up until the open river depth is nine feet. The length of time that the dams



MONONGAHELA RIVER DAM, NO. 5, AND LOCK

are up, of course, varies according to the character of the seasons. While some dredging work will be done, the lock and dam construction is depended upon mainly to provide the 9-foot depth.

Beginning at the head of the Ohio, its principal tributaries which have heretofore received the attention of the Federal Government are the Allegheny, Monongahela, Muskingum, Little Kanawha, Kanawha, Big Sandy, Kentucky, Green, Wabash, Cumberland, and Tennessee Rivers. Upon these, some seventy locks and dams have been constructed and are being maintained, which, together with a canal eighteen miles long in connection with the Tennessee River navigation, furnish 1000 miles of slack-water navigation, or together more than the entire length of the Ohio River. The permanent navigable portions of these tributaries reach out

into many of the most important mineral regions of the Ohio basin, affording communication with the main traffic of the great agricultural regions bordering thereon and of many thriving industrial communities.

The improvement of the Monongahela River, which has so efficiently accommodated the coal and iron industries of the Pittsburgh district to the south, and has added so materially to the industrial development of

MONONGAHELA RIVER IMPROVEMENT. CLOSING OF DAM NO. 5

the world's great steel-producing center for a distance of more than fifty miles up that stream, was first undertaken by the Monongahela Navigation Company, a corporation of the State of Pennsylvania, about 1838. Within six years permanent navigation had been extended nearly sixty miles, to a point above Brownsville, Pa. Its subsequent extensions were carried to the line of West Virginia, near Greensboro. In the meantime and prior to 1883 the United States Government undertook the improvement of the Monongahela River within the State of West Virginia, extending continuous navigation by means of Locks and Dams 8 and 9 to Morgantown, 100 miles above Pittsburgh. These two structures were accomplished at a cost of $437,000. In 1897 the United States Government purchased the property rights of the Monongahela Navigation Company,

comprising Locks and Dams 1 to 7, inclusive, at a cost of $3,769,073.89. During the next eight years the Federal Government, at a cost of $1,200,000, constructed Locks and Dams 10 to 15, inclusive, extending the slack-water navigation to Fairmont, W. Va., 130 miles above the mouth of the river.

Within a few years after Government acquisition of the Monongahela Navigation Company's locks and dams, the traffic on the lower Monongahela increased practically 100 per cent., and necessitated the enlargement of the old locks at least as far as No. 5 at Brownsville.

With the exception of one small lock at Dam 4, between Monessen and Charleroi, all of the other structures have been rebuilt, the locks of much larger capacity and the entire structures of concrete throughout, rendering them more durable and efficient for the maintenance and conduct of a large commercial movement on a stream with exceedingly small low-water discharge. To further facilitate the rapid movement of commerce double locks have been provided for each of Dams 1 to 5, inclusive, covering the lowermost seventy miles of river. The new locks are 56 feet by 360 feet in their useful dimensions, and the dams by means of movable crests are arranged to furnish a least depth of 9 feet for navigation purposes. The reconstruction of these locks and dams, together with the enlargement of Lock 6, which has practically been accomplished within the last eight years, has been done at a cost of $2,526,000. The entire cost of the Monongahela River navigation plant to the United States, including the purchase of the old locks and dams from the Monongahela Navigation Company, their reconstruction and the erection of the locks and dams above them to Fairmont, comprising fifteen dams with twenty locks, and covering a distance of 130 miles, is approximately $8,000,000.

Upon the slack-water pools of the Monongahela River there are annually transported from eleven to twelve million tons of freight, and the improvement is capable of handling several times that amount. Furthermore, the greater number of the structures are practically new and of the latest design and construction, thus affording better facilities for the safe and rapid movement of heavily loaded craft than at any time in the past.

Within recent years considerable local agitation has again attracted the attention of Congress to the improvement of the Youghiogheny River, the most important tributary of the Monongahela, which joins the main stream at McKeesport, fifteen miles above Pittsburgh. After a most careful investigation Congress deemed this stream worthy of improvement

at the present time up as far as West Newton, sixteen miles above its mouth, and has appropriated, for preliminary work in connection with the construction of locks and dams thereon, $100,000.

For various reasons the Allegheny River, like the Ohio, of which it is one of the parent streams, has been delayed in its permanent improvement. As far back as 1828 this river was surveyed by the United States, and its

STEAMER "SPRAGUE" TOWING A FLEET OF PITTSBURGH COAL BARGES

worth as a navigable waterway and the remarkable mineral resources were determined. However, it was not until 1878 that active operations were instituted for the removal from its channel of the enormous quantity of huge boulders which lined its navigable course. In the early nineties, when these had been effectually removed and numerous low-water dikes and dams in the interest of an open-river navigation had been constructed, the erection of the first lock and dam at Pittsburgh was undertaken. Within the next twelve years this structure and two additional locks and dams, extending slack-water to Natrona, twenty-five miles above the mouth, were completed at a cost of $1,675,000. Again progress on this stream was delayed, owing to litigation looking to the raising and widening of spans of certain bridges affording inadequate facilities for the passage of modern towboats, operating on the Monongahela and Ohio Rivers, at the more desirable navigable stages of the

water. This having been accomplished in a measure only, Congress has again authorized an examination into the needs of the stream for the extension of its slack-water navigation, and the Rivers and Harbors Committee of Congress recently personally examined the stream from Oil City to the mouth, a distance of 134 miles, and were much impressed with the importance of the valley from the point of view of its mineral resources and the industrial activities on its banks.

In but few valleys in this or any other country has nature been more generous in the distribution of her mineral wealth than in the Allegheny. Coal of excellent quality, limestone, building stone, silica rock for the manufacture of glass and especially of plate glass, fire clay of finest quality and other clays and shales suitable for the manufacture of brick, sewer pipe, etc., pottery clay, iron ore, petroleum, natural gas, gravel and sand for concrete building purposes, timber, etc., in enormous quantities, are found throughout different portions of the Allegheny Valley, especially on the lowermost 100 miles.

Special effort has recently been made to obtain appropriations for five additional locks and dams on the Allegheny. The estimated cost is $2,778,000, and the Chief of Engineers has made a favorable recommendation on the project. The proposed improvements are:

No.	Location	Distance from mouth (miles)	Lift (feet)	Total Cost Concrete Construction
4	Natrona	24.	12	$483,000
5	Near Murphy's Island	31.6	12	580,000
6	Near Clinton	37.	12	619,000
7	Kittanning	46.	13	580,000
8	Near Mosgrove	53.3	15	526,000
				$2,788,000

With the improvements of the Ohio and its tributaries completed that are now under way or contemplated, this system of rivers will afford an outlet to the sea at the south, and to the Panama Canal for the vast tonnage of this great region. Should the proposed Lake Erie and Ohio River Ship Canal be cut, it would complete an unequalled system of inland navigation.

The Gateway to the Sea

THE navigable channel of the Delaware River extends from the head of Delaware Bay—from which point there is deep water to the ocean—to Trenton, on the north. Operations are now under way for the deepening of the channel from Philadelphia to the bay to a depth of 35 feet, and between Philadelphia and Trenton to a depth of 12 feet. The estimated cost of the 35-foot channel is $10,920,000. Its width in the straight parts is to be 800 feet, the width at Bulkhead Bar, 1200 feet, and at the other bends, 1000 feet. The distance from Philadelphia to the Capes is about one hundred miles, and the section under improvement is 63 miles in length. The range of tide is from 5 to 6 feet, so that a channel of 35 feet at mean low water will give a depth at the top of the tide of 40 to 41 feet. It is estimated that the deeper channel could be completed by the end of the year 1916.

Systematic improvements on the river were begun in 1885, when a project was authorized looking to a channel 26 feet in depth at mean low water, and 600 feet in width. This channel was planned to extend from a point a quarter of a mile above Allegheny Avenue, Philadelphia, to deep water in the bay. In March, 1899, a larger project was adopted, which provided for a channel 30 feet in depth and 600 feet in width. This, however, did not include Philadelphia harbor, but, instead of extending as far north as Allegheny Avenue, extended north only as far as Christian Street, Philadelphia. Work under this project was carried on up to March, 1911, when it was considered as practically completed. The total expenditures on channel improvements up to that time, and dating back to 1836, aggregated $10,176,002.08. This did not, however, include the cost of the removal from Philadelphia harbor of Smith's Island and Windmill Island, a work which was completed in 1898, and which cost $3,945,424.75.

During the progress of the 30-foot channel work there was a disposition on the part of the National Congress to await definite information as to the cost of maintenance before embarking upon a greater project. The alluvial character of the river, and the difficulty of maintaining the channel over certain of the shoal areas, presented problems which

Congress waited to see solved before making appropriations for greater channel depths.

Insistence on the part of the important commercial interests of the Delaware, however, resulted in a provision in the River and Harbor Act, March, 1909, for a survey and examination of the Delaware from Allegheny Avenue to the sea, "with a view to obtaining a channel 35 feet in depth and of suitable width."

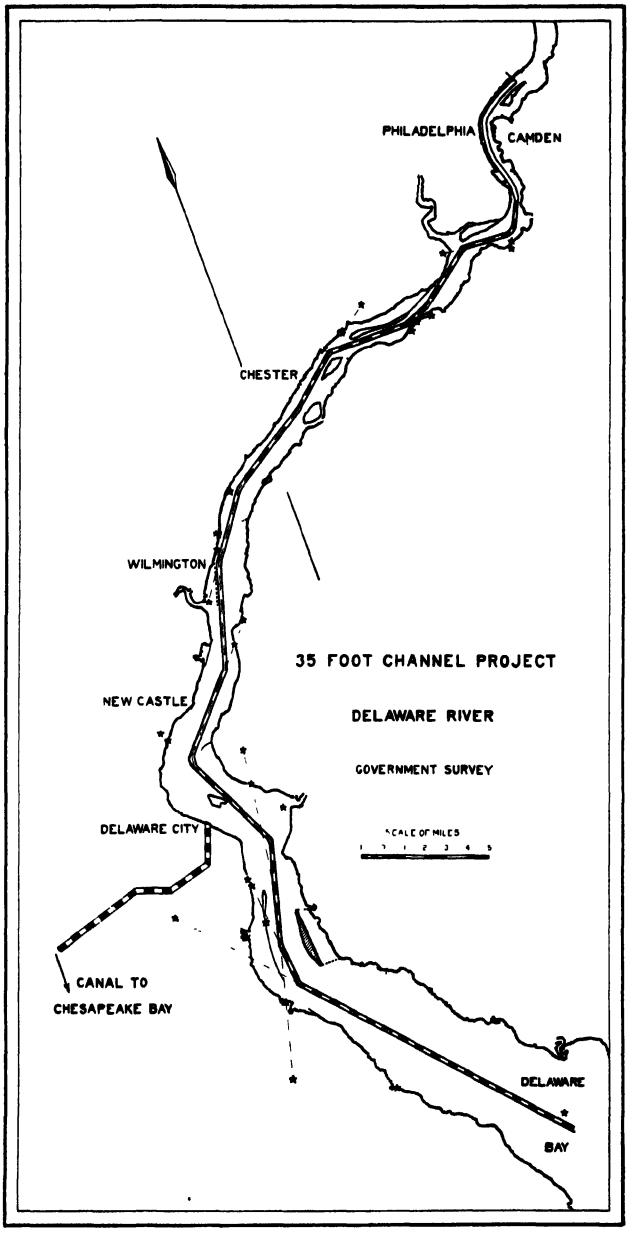
The plan, as adopted, provides for an important extension of the system of dikes upon the river, with a view to systematic contraction and control of the tidal flow. While more or less diking had been done in the earlier work, it was not upon so wide a scale as under the newly adopted project. Important construction had, of course, been done to contract the cross-section of the river in certain sections of great width. There had been built, for instance, opposite Reedy Island, an artificial island 15,500 feet long and 2240 feet wide at its widest point. The building of this island was decided upon after an objection, raised by the interests in lower Delaware, had made impossible the construction of a dike along the Delaware side. This dike, as proposed, would have shut off the access to several streams in Delaware emptying into the bay, and the protest was so determined that it was found necessary to abandon the diking plan, and to construct, instead, this large artificial island close to the New Jersey shore. Among other operations intended to control the tidal flow under the 30-foot project, was a dike on the Delaware side, at Edgemoor, above the city of Wilmington. This was partly constructed under the 30-foot channel project.

The proposed system of dikes is planned with a view to reducing the cost of maintaining the channel, and the need of these works will be greater under the newly adopted project than under the 30-foot channel project, as a far greater amount of dredging would be necessary if dredging alone were to be depended upon.

The first of these new works below Philadelphia is the raising of Mifflin Bar dike to mean high water and its extension at that height to Tinicum Island. This will cut off a secondary channel.

The second of the series is at the upper end of Chester Island, which is to be connected with Mond's Island. This, besides contracting the flow and cutting off a secondary channel, will furnish a basin for the deposit of dredged materials.

Improvement of the troublesome shoal at Cherry Island Flats contemplates the completion of the now partly constructed Edgemoor bulk-


PHILADELPHIA
CAMDEN
CHESTER
WILMINGTON
NEW CASTLE
DELAWARE CITY
CANAL TO
CHESAPEAKE BAY
35 FOOT CHANNEL PROJECT
DELAWARE RIVER
GOVERNMENT SURVEY
SCALE OF MILES
1 0 1 2 3 4 5
DELAWARE
BAY

head to connect it with the jetty on the north side of Christiana River. A high-tide dike on the New Jersey side at Old Man Point, above Edgemoor, will concentrate the flow in the adopted channel. The Edgemoor bulkhead, when completed, will enclose a basin about 1000 acres in extent, which is to be used for the deposit of dredged material.

It is also planned to connect the artificial island with the Jersey mainland. It had been found that a strong scour resulted between this island and the mainland, and one purpose of the dike to connect the island with the land is to cut off this secondary channel. A dike is also planned to extend two miles from the lower end of Reedy Island, and another, a spur dike, is to be constructed opposite Liston Point.

While it has been found that the numerous cities, towns, tributaries, and bends make it almost impossible to carry out a scheme of reducing the river to a regular form, it has been decided that the most practical treatment appears to be the construction of these works to improve conditions between the points of good, natural depths without obstructing the flow of the tides. Specifications for the construction of four of the dikes, located respectively at Chester Island, Old Man Point, Reedy Island, and the lower end of Artificial Island, were approved June 22, 1911, and this work is now under contract.

In the cutting of the deeper channel, the lines of the 30-foot channel will be adhered to except at Schooner Ledge, opposite Chester. This obstruction in the river is a large ledge with several outlying small ledges, the whole extending over a distance of 3300 feet. Under the former project this was cut to 30 feet in depth, government plant being used. When the 35-foot survey was made, however, it was found that the construction of a deeper and wider channel on the present lines would necessitate so great an amount of rock excavation as to make the cost excessive. It was found also that east of the rock area the bottom of the river is of soft material, and that the shifting of the channel to the eastward would mean much less expense. A disadvantage of the shifting of the line is that the city of Chester will be farther removed from the deep ship channel; but it was the opinion of the engineers that the 30-foot depth at mean low water, over Schooner Ledge, would be ample to provide for the needs of that city for many years to come.

It is estimated that the cost of maintenance will be $300,000 a year. Recent operations have indicated that this estimated maintenance cost is liberal. Maintenance operations have recently been conducted by the suction dredge "Delaware," which was built by the Government for use

in the Delaware River, and by the dredge "Manhattan." These two dredges of the suction type, working steadily, have been able not only to maintain the channel, but to reduce the accumulation of past years. Recent surveys of the river show depths in the channel over the shoal areas ranging from 28 feet to 32 feet, and, while these depths do not extend over the entire channel width, they furnish a navigable path for

SAND AND COAL WHARVES, SCHUYLKILL RIVER, PHILADELPHIA

deep-draft vessels. These maintenance operations indicate that two dredges of the most modern type are sufficient to properly maintain the deeper channel.

The greater part of the shoaling which takes place in the channel is below Schooner Ledge; it is composed of very soft mud, and it is difficult to fill the dredges' bins with solid material when working in such localities. The dredges when operating in this locality have pumped directly overboard on ebb tide, so that the light material would be carried by the tide toward deep water in Delaware Bay. On flood tide the material was held in the bins and deposited at Deep Water Point, N. J., and back of Artificial Island, to be rehandled

During the season of 1912 there will be expended on dikes the sum of

$600,000, and on dredging under the 35-foot channel project an equal amount, making a total of $1,200,000. The River and Harbor Act of February 27, 1911, appropriated $800,000 for the deeper channel. The balance unexpended July 1, 1910, was $825,000, making a total amount provided up to and including the act of February 27, 1911, of $1,625,000. In addition to this, contracts to the amount of $700,000 had been authorized by Congress to be paid as appropriation is made. Liberal provision for the continuance of the work is made in the River and Harbor Bill of 1912. The total appropriations for the river up to and including February 27, 1911, are as follows:

Total from 1836 to December 31, 1902, previous to adoption of existing project, as per House Document No. 421, Fifty-seventh Congress, second session, page 340	$4,204,000.00
March 3, 1903	1,400,000.00
April 28, 1904	1,000,000.00
March 3, 1905	500,000.00
June 30, 1906	1,000,000.00
March 2, 1907	895,000.00
May 27, 1908	375,000.00
March 3, 1909	390,000.00
March 4, 1909	125,000.00
June 25, 1910	800,000.00
February 27, 1911	800,000.00
	$11,489,000.00

In addition to this there has been appropriated for work of improvement in Philadelphia harbor $3,950,000, making a total of $15,465,529.22 before the beginning of the year 1912.

It is not alone the importance of the general commerce of the Delaware that has been considered by Congress in its decision to undertake this work. Important as this commerce is, the special interests of the Government itself justify the improvement. The principal shipbuilding interests of the country are on the Delaware. The Philadelphia Navy Yard, because of its protected position, its equipment, the extent of its territory, and its fresh-water basin for the storage of ships, holds a place that is second to none among the navy yards of the country. It has a unique position by reason of its proximity to an excellent labor market and an inexhaustible fuel supply. If it shall be determined, as it may be, that there is to be but one great naval station upon the Pacific and another upon the Atlantic, the yard at League Island is, without doubt, the most suitable among Eastern yards from the standpoint of naval strategy as well as of economy and convenience. Besides these reasons for the

improvement of the channel, there is the added reason that the commerce of the Delaware pays into the national treasury approximately $20,000,000 annually. In the calendar year 1911 the duties collected in the port of Philadelphia amounted to $20,713,208.

The Delaware carries more commerce and does a greater business for the Government than any other river in the United States. The

TRANSATLANTIC PIERS, DELAWARE RIVER, PENNSYLVANIA RAILROAD

following summary of the freight movement gives an idea of the extent of this traffic:

	1909		1910	
	Quantity Tons	Value	Quantity Tons	Value
Foreign:				
Arrivals	2,234,039	$78,001,864	2,948,179	$89,646,337
Departures	3,041,433	80,503,231	2,532,677	65,256,949
Domestic:				
Arrivals	8,955,449	626,599,621	9,124,659	643,059,246
Departures	10,446,750	542,765,146	10 890,698	542,429,362
Total	24,667,671	$1,327,869,862	25,496,213	$1,340,391,894

The imports and exports of the Port of Philadelphia and the revenue collected is shown by the following figures:

	EXPORTS		IMPORTS		
Years	Quantity Tons	Value	Quantity Tons	Value	Revenue
1901	3,183,584	$79,324,344	1,279,044	$51,365,142	$19,046,007
1902	2,748,839	76,022,896	1,679,403	55,064,776	22,360,362
1903	2,378,307	73,184,394	1,561,052	55,516,052	21,020,331
1904	2,552,065	66,539,909	1 057,348	53,852,194	17,997,700
1905	3,267,439	70,645,103	1,365,245	67,913 822	20,022,804
1906	3,800,995	88,276,315	1,732,935	72,137,678	20,505,545
1907	4,056,716	106,570,527	1,800,520	80 693,324	21,044,374
1908	3,532,472	95,533,079	1,551,015	57,407,933	16,963,929
1909	3,041,433	80,503,231	2,234,039	78,001,864	20,810,442
1910	2,532,677	65,256,949	2,948,179	89,646,337	21,888,285

During the calendar year ending December 31, 1911, the port of Philadelphia made a new commercial record, a greater number of vessels with larger tonnage having arrived here during that period than in any previous year. The gain was chiefly centered in the movement to and from coastwise ports, nearly all vessels available for that service having been placed in use.

A VIEW OF THE PHILADELPHIA HARBOR FRONT

The foreign and coastwise arrivals for the year 1911, as recorded in the office of the Commissioners of Navigation, numbered 6286, or a gain of 97 vessels. The aggregate tonnage, as represented by the 6286 vessels for the year 1911, was 10,217,388, as against 6189 vessels with an aggregate tonnage of 9,871,667 during 1910.

Of the items in the coastwise trade, the greatest increase is shown in general cargoes brought here by the regular line steamships. Substantial increases were also shown in the fleet of vessels that arrived with oil from the Texas fields, pulp wood, mine props, pig iron, cinders, stone, phosphate rock, wood blocks, and coal-tar products. Comparative figures of large items for the two years follow:

	1910	1911
Lumber ..... feet	396,323,052	219,884,525
Oil ..... barrels	3,112,981	3,317,787
Shingles	6,111,000	4,000,000
Railroad ties	3,673,694	1,397,425
Mine props ..... tons	63,720	81,926
Pulp wood ..... cords	17,363	42,860
Pig iron ..... tons	28,492	41,294
Cinders ..... tons	13,100	34,282
Stone ..... tons	23,459	32,165
Sand ..... tons	10,095	14,695
Phosphate rock ..... tons	14,399	60,738
Wood blocks ..... tons	1,800	4,720
Coal tar ..... barrels	.....	44,225

Anthracite and bituminous coal shipments for 1911 to foreign and coastwise ports totalled 3,987,748½ tons. Of this amount, 1,439,293½ tons were anthracite coal and 2,548,455 tons bituminous coal.

The rig, number, and tonnage of vessels which arrived at the Port of Philadelphia from foreign and coastwise ports during 1910, as compared with the twelve months ending December 31, 1911, is shown in the following table:

	FROM FOREIGN PORTS 1910		FROM FOREIGN PORTS 1911	
Rig	No.	Tonnage	No.	Tonnage
Steamships	1286	4,553,242	1233	4,558,621
Ships	....	.....	4	7,167
Barks	21	26,567	24	26,859
Brigs	....	.....	2	840
Schooners	71	32,027	68	32,352

	FROM COASTWISE PORTS—1910		FROM COASTWISE PORTS—1911	
Rig	No.	Tonnage	No.	Tonnage
Steamships	1737	2,919,455	1789	3,068,982
Ships	9	23,305	4	10,208
Barks	11	14,118	7	13,391
Brigs	....	.....	....	.....
Schooners	672	479,515	623	512,133
Barges	2381	1,815,720	2532	1 986,835
Total	6189	9,871,667	6286	10,217,388

The Upper River Channel

Between Philadelphia and Trenton, N. J., the river is being deepened to 12 feet. This section of the river is about thirty miles in length. In its original condition it was obstructed by several shoals. At Five-Mile Bar, between Allegheny Avenue and the Pennsylvania Railroad bridge, a shoal extended across the channel from the Pennsylvania side. Kinkora Bar was the next obstruction, and there was also a shoal area from Bordentown to Trenton, a distance of about five miles. The depth of the channel through the shoals varied from three to six feet at mean low tide.

No comprehensive project had been adopted for the improvement of this part of the river prior to 1910, although at various times since 1872 work was done at different localities with a view to obtaining a depth of 7 feet at mean low tide and a channel width of 200 feet. The amount expended in channel improvement between Philadelphia and Trenton prior to the adoption of the new project was $197,423.48.

Awakening interest on the part of the city of Trenton to the importance of obtaining an outlet to the sea resulted in the adoption of the new project, which provides for a channel 12 feet deep at mean low water and

200 feet in width. The estimated cost of the improvement is $360,000, and the cost for maintenance $20,000 a year. The plan for this improvement provides for the construction of dikes at Bordentown and at Biles Island, near Trenton. The Bordentown dike, which is now completed, extends from Duck Island to the locks on the Delaware and Raritan Canal. This dike is one mile in length, and consists of a timber fence with gravel and cobble at either side. The timber acts as a core wall, preventing the wash of the currents. The coarse gravel and cobble used in the construction was pumped direct from the channel of the river.

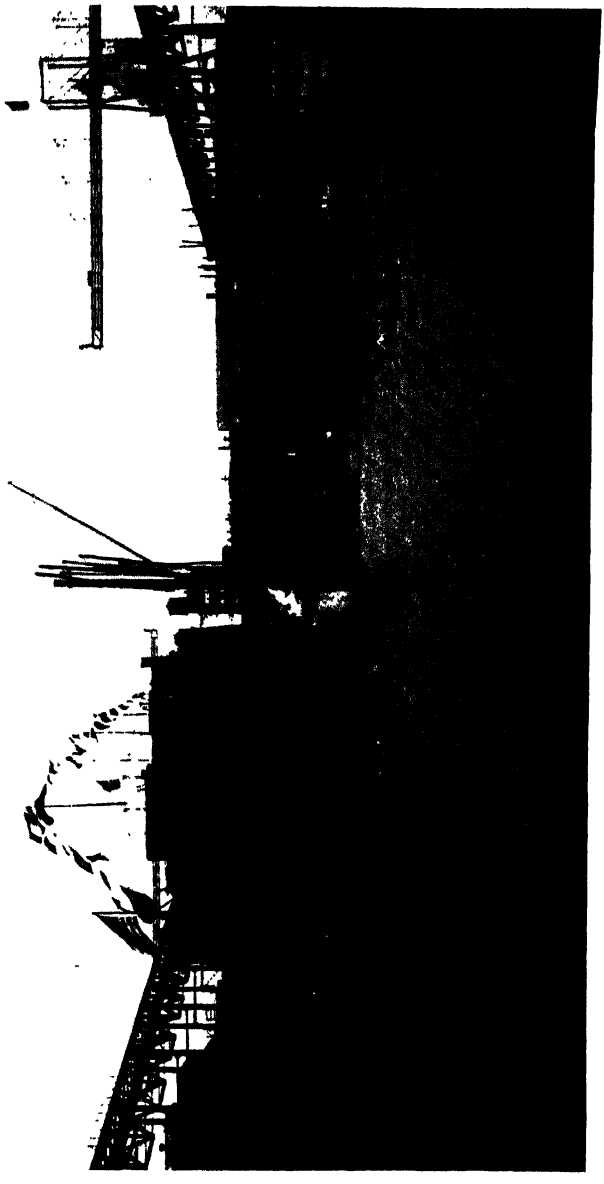
When the proposed channel is completed the depth will be 18 feet at the top of the tide to a distance of twenty-six miles above Philadelphia. This will make it possible for large sea-going vessels to proceed as far as the Roebling works, below Trenton.

Although having a rise of tide of four feet, and with a path for commerce cut to the deep channel, Trenton manifested but little interest in the systematic development of its water front until the year 1907. In that year Frederick W. Donnelly, since elected mayor of the city, began an active crusade for the improvement of the water-front facilities. A comprehensive plan was adopted, and an act was passed by the New Jersey Legislature, giving to cities the right to issue bonds for the purchase of land and the control of water fronts. This act also created a harbor board. A start toward municipal control has been made, and the city now has the ends of five streets, while negotiations are now under way with property owners with a view to opening the balance of the water front for a distance of 2000 running feet. The city of Trenton has appropriated $50,000 for this work, while an additional $50,000 is assured to begin the building of Pier No. 1. The total cost of the water-front improvement, when completed, will be $1,000,000. The city has also acquired twenty acres of land one-eighth of a mile below Lalor Street for a sewage disposal plant. This improvement will include the construction of 1800 feet of bulkhead, which will provide that amount of free dockage.

It was this activity on the part of the city of Trenton that very largely influenced the Government in making provisions for the improvement of the river from Philadelphia to Lalor Street, and also for improving the Trenton river front.

The National Harbor of Refuge

In addition to work on the channel, the Government has constructed at the entrance to Delaware Bay the National Harbor of Refuge for storm-



U. S. BATTLESHIP "WYOMING" ON THE WAYS READY FOR LAUNCHING: CRAMPS' SHIPYARD

distressed shipping along the dangerous New Jersey and Maryland stretch of coast.

The project for this improvement was adopted June 3, 1896. Work on the breakwater located along the eastern branch of the shoal known as the "Shears" was commenced May 4, 1897, and completed December 11, 1901. The substructure of the breakwater has a length of 8040 and the superstructure a length of 7950 feet, measured on the low-water line. Work on the fifteen ice piers across the upper end of the harbor to protect it from moving ice descending the bay was commenced in October, 1900, and completed June 19, 1903, the work having been done under two subprojects, dated April 23, 1900, and June 30, 1902, providing for ten and five ice piers respectively. The amount of stone deposited in this work was 108,973 tons. The amount expended to the close of the fiscal year ending June 30, 1911, was $2,245,771.83.

The great value of this harbor to commerce is due to its location. It is about equidistant from New York, Philadelphia, and the capes of Chesapeake Bay (the ocean entrance for the ports of Baltimore, Norfolk, and Newport News), and is therefore an especially convenient port of call for the entire commerce of the North Atlantic coast. It is now largely used by vessels awaiting orders to ports for discharge or loading. During the year ending December 31, 1910, 991 vessels, not including small craft, called at this harbor.

By the construction of the breakwater the usefulness of this anchorage has been greatly increased, not only as a port of call, but also as a harbor of refuge. Vessels bound from Northern to Southern or from Southern to Northern ports are able to go to sea in doubtful weather with the assurance of finding ample protection at the Delaware Capes if overtaken by storm.

The Port of Philadelphia

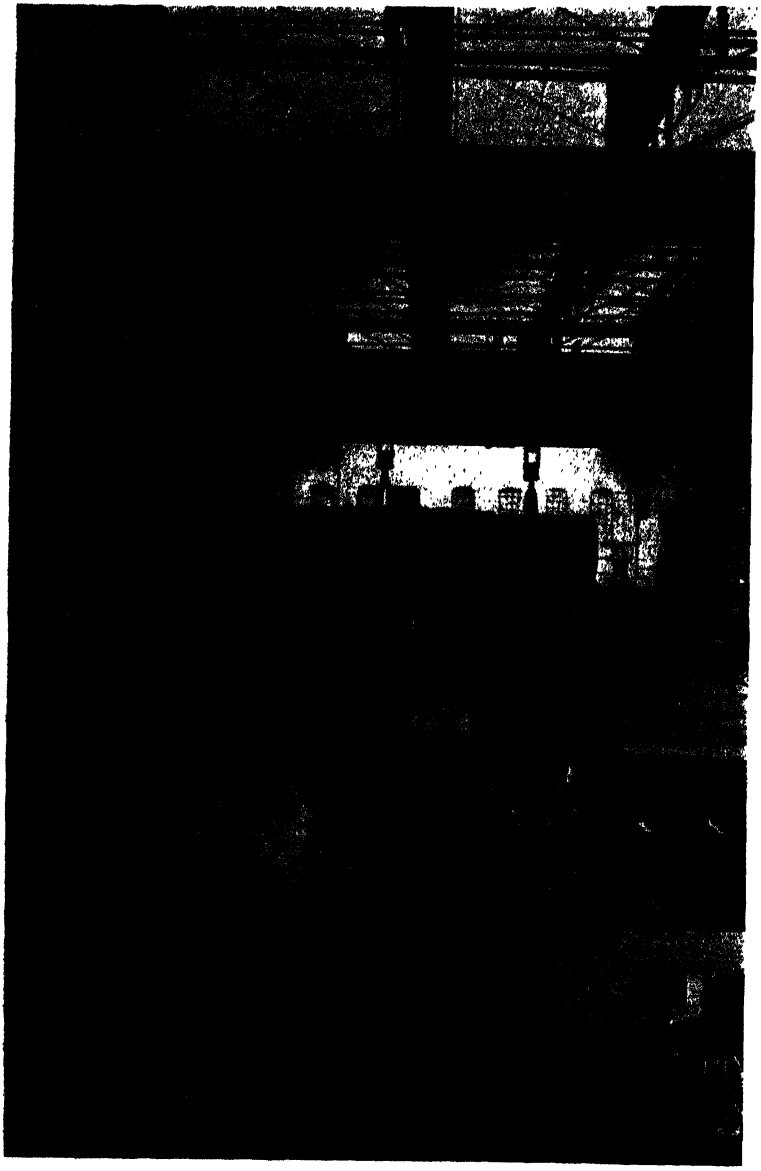
IN RECENT legislation for the improvement of rivers and harbors the Congress of the United States has shown a disposition to take into consideration the amount that the localities themselves are expending for improvement, and to provide more liberally where cities or States are manifesting their interest by appropriating money for the work.

Recognizing the soundness of this policy, the city of Philadelphia has already embarked upon, and is planning to provide liberally for, a broad scheme of harbor improvement. In the past, both city and State have aided in meeting the cost of Delaware channel work, and the new comprehensive plan contemplates a large increase in the port facilities by city appropriation.

There has recently been completed a new municipal pier at Vine Street on the Delaware River, known as No. 19, North Wharves. This is the most modern of the piers on the Delaware and Schuylkill rivers; it is 571 feet long and 166 feet wide, and is of the open type, resting on piles. From the level of 2 feet 10¼ inches above low water, the substructure consists of reinforced concrete, which makes it a permanent structure. The lower or main deck is of reinforced concrete resting on steel beams, paved with wood blocks. The surface of this deck at the sides of the pier is 13.5 feet above mean low water.

The superstructure is double deck, the first deck having a height of 20 feet and ½ inch from deck to lower side of girders; the upper deck having a height of 16 feet and ½ inch from deck to lower chord of roof truss. The superstructure is entirely of reinforced concrete and steel, faced with copper on the outshore and inshore ends, thus making the entire structure fireproof. There are three towers on the pier—the one on the river or outer end has a height of 112 feet above the street level, and the two on the inshore end have a height of 100 feet above the street level. The street level in that vicinity is 11 feet above mean low water. The construction of this pier cost $684,774.90, and the purchase of additional land $302,000, making a total cost of $986,774.90.

On August 3, 1911, a contract was awarded for the removal of old



BALDWIN LOCOMOTIVE WORKS, PHILADELPHIA. ERECTING SHOP

piers and obstructions from the site of a proposed new pier and bulkhead at the foot of Dock Street, Delaware River, which work was completed under date of December 29, 1911, at a cost of $29,400.

On November 21, 1911, a contract was awarded for the construction of a pier and bulkhead at the foot of Dock Street, Delaware River, for the sum of $279,500. This pier will be 120 feet wide and 570 feet long, of open type, resting on piles; the superstructure to consist of one-story freight shed and a two-story head-house for offices on inshore end.

The department is now considering plans for the construction of two large trans-Atlantic piers to be located along the Delaware River at some point not yet decided, but which will be in the built-up portion of the city, within one mile from Market Street. Contracts have recently been made for several pieces of bulkhead construction, among them a concrete bulkhead along the easterly line of Delaware Avenue, from South Street to Christian Street and from Callowhill Street to Fairmount Avenue and Penn Street, to cost $250,000. When this bulkhead is completed it will widen Delaware Avenue, which is the marginal commercial avenue of the city, to its full width of 150 feet from Christian Street on the south to Fairmount Avenue on the north—a distance of 9800 feet. The new bulkhead work will also include improvement of the Schuylkill River front.

The city during the years 1910 and 1911 purchased, at a cost of $249,708, a dredging plant, which consists of: One 18-inch hydraulic dredge, one combination dredge (scoop and clamshell, 5-yard bucket), one 55-foot tugboat, one 81-foot tugboat, four 500-cubic-yard bottom-dump scows, three 250-cubic-yard bottom-dump scows, one deck scow, one deck and derrick scow, and fifteen pontoons.

During the last four years the Department of Wharves, Docks, and Ferries has removed, by contract with outside dredging concerns and its own plant, 1,676,367 cubic yards of material from the Delaware and Schuylkill river-channels, city docks, and private docks where municipal sewers empty.

The present city administration has declared in favor of the expenditure of $20,000,000 for the improvement of harbor facilities, and the Department of Wharves, Docks, and Ferries is now working upon a general plan of improvement.

This general scheme of improvement will place the port of Philadelphia in line with other progressive Atlantic ports. The city has recently manifested a growing appreciation of its responsibility in the

matter of harbor improvement and the extension of dock facilities, if it is to expect the Federal Government to proceed rapidly with the 35-foot channel work. The Congressional delegation in Congress is pressing for increased appropriation for the channel, in order that this great work of improvement may be completed at the earliest practicable day. In the past, the arguments in favor of channel deepening have been countered

SHIPS AWAITING DELIVERY, NEW YORK SHIPBUILDING COMPANY'S YARDS

by the argument that the improvement of port facilities should proceed, at least, as rapidly as the work of channel improvement. The broad plan of improvement, which is now being shaped by the city authorities, clearly indicates that it is the purpose of the city of Philadelphia to be prepared for the enlarged commerce which will come with the deepening of the channel to the sea, and to provide docking facilities for the largest vessels that will use the deeper channel.

By an Act of Assembly of the State of Pennsylvania, approved the eighth day of June, 1907, there was established in the port of Philadelphia a Board of Commissioners of Navigation for the River Delaware and its navigable tributaries. The board consists of five members, and the Director of Wharves, Docks, and Ferries, who is one of the members,

acts as president. Two are appointed by the mayor of Philadelphia, one from the Maritime Exchange of Philadelphia, one from the Philadelphia Chamber of Commerce, one by the Councils of the City of Chester, and one by the Council of the Borough of Bristol.

The commissioners are empowered to "make rules for the regulating, stationing, and anchoring of ships, vessels, and boats in the River Delaware and its navigable tributaries, or at wharves, piers, or bulkheads,

WORKS OF THE J. G. BRILL CAR COMPANY, PHILADELPHIA

or in the docks, slips, or basins extending into or on the said river and the navigable tributaries; for removing, from time to time, ships, vessels, and boats, in order to accommodate and make room for others, or for admitting river craft to pass in and out of docks, slips, and basins, and for compelling the masters and captains of ships, vessels, and boats to accommodate each other, so that ships, vessels, and boats shall for a reasonable time be entitled to berths next to the wharves, piers, and bulkheads until they have landed or loaded their cargoes."

The board has power to make surveys and soundings to ascertain the capacity of the river and its navigable tributaries for commercial purposes, and to prepare plans therefrom and to keep reports thereof. It has power to establish bulkhead and pierhead lines and the distance between piers, subject to the regulations of the United States Government; to adopt and promulgate rules and regulations for the construction, extension, alteration, improvement, and repair of wharves, piers, bulkheads, etc., outside the limits of the city of Philadelphia. It is also vested with power to grant licenses for the extension of wharves, piers,

or other harbor structures, or building in the nature of a wharf or harbor structure, outside the limits of the city of Philadelphia. The board has full power to grant licenses to persons to act as pilots in the Bay and River Delaware, and to make rules for their government while employed in that service; to decide, on application of parties in interest, all differences which may arise between masters, owners, and consignees of ships or vessels, and pilots, and to make, ordain and publish rules and regulations. They may impose such penalties for the breach thereof in respect of the masters aforesaid as they shall deem fitting and proper.

Upon the creation of the Board of Commissioners of Navigation, the Board of Wardens for the Port of Philadelphia and the offices of the Harbor Master and the Master Warden of the Port of Philadelphia were abolished, and the functions (excepting the granting of licenses for the construction of wharves, etc., in the city of Philadelphia) of the three offices above mentioned were vested in the new board.

Under the new project for the 35-foot channel in the Delaware River, it is provided that, in order to permit free anchorage and movement of vessels in the harbor of Philadelphia, the channel shall have a width of 1000 feet in front of the city. The anchorage areas in Philadelphia harbor are at League Island, Greenwich Point, Cooper Point, and Port Richmond. In order to accommodate the commerce of the city of Camden, one of the principal features of which is a large lumber trade, it is proposed to dredge a channel 15 feet deep along the business portion of the city front where such depth does not already exist.

Lake Erie and Ohio River Ship Canal

INSISTENCE upon internal waterway development along broad lines is strikingly manifested in the demand of the manufacturing interests in western Pennsylvania for a ship canal that will float the ore of the Lake Superior region down from Lake Erie to this constantly expanding center of industry.

Several rail lines now transport this ore. Into the Pittsburgh region in 1910 there moved 41,517,641 tons of ore, while a tonnage of more than 18,000,000 tons of soft coal moved outward from the mines of Pennsylvania. As this tonnage has grown, there has been found the need of greater and still greater transportation facilities. To-day the United States Steel Corporation has its own road, the Bessemer and Lake Erie, while each of the other lines that connect the district with the lakes carries a large volume of ore tonnage.

The route of the Lake Erie and Ohio River Ship Canal as proposed is from Pittsburgh north and west through the wonderful commercial district of the Beaver Valley to Pennsylvania State line; thence through Ohio to Ashtabula on Lake Erie. The length of the canal as proposed is 103 miles. The route is practically a straight line between the points where the Ohio River and Lake Erie come nearest together. One-half the distance, or about fifty miles, consists of rivers whose canalization presents no insurmountable engineering difficulty and few difficult problems. The route crosses at the lowest divide of any feasible route between lake and river.

The proposed dimensions of the canal are:

Beaver River	Bottom width	175 feet
	Minimum depth	13 "
Mahoning River	Bottom width	150 "
	Minimum depth	13 "
Canal proper	Surface width	177 "
	Bottom width	131 "
	Minimum depth	13 "
Lock dimensions	Available length	360 "
	Width	56 "
	Over lock sills, depth	12 "

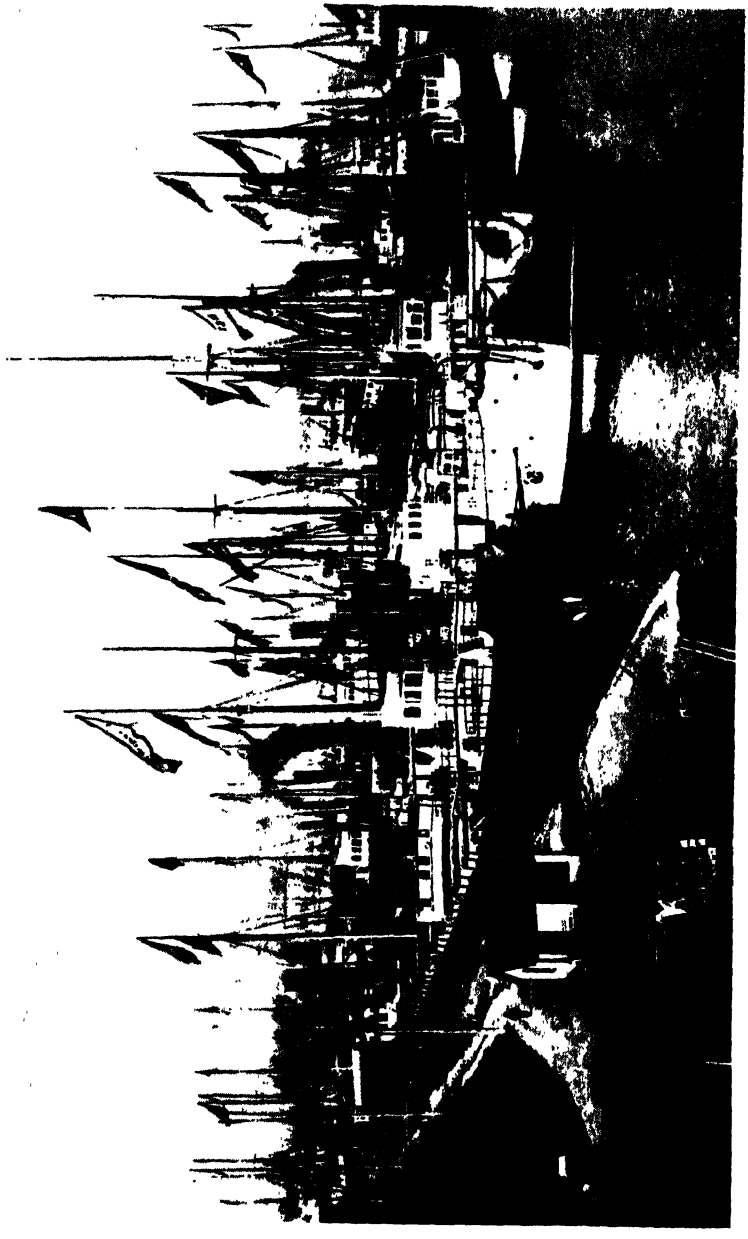
Locks to be built to allow a depth of 15 feet when desired.

Important to the commercial interests of the western part of the State as this canal is held to be, and though it is declared by engineers to be entirely feasible, a number of years have elapsed since the agitation for the undertaking was begun, and as yet the work is not started. This delay bears a parallel to that which preceded the inauguration of the intracoastal waterway chain along the Atlantic seaboard.

DAIQUIRI IRON MINE, CUBA. ORE SHIPPED TO PENNSYLVANIA

A commission, appointed by the Legislature as early as 1889, surveyed the proposed route of the canal, considered the project in all its bearings, and declared it to be entirely feasible. Six years later a committee of the Pittsburgh Chamber of Commerce made a further exhaustive examination into the canal project, and pronounced it to be practicable and a commercial necessity. However, the next step was delayed ten years until in May, 1905, a charter was granted to the Lake Erie and Ohio River Ship Canal Company. A national charter was granted by act of Congress a year afterward. In June, 1911, Lieut. Col. H. C. Newcomer, of the United States Corps of Engineers, stationed at Pittsburgh, made a report in which he expressed the opinion that the project is practicable and of sufficient national importance to justify the Government's co-operating with local interests to provide the necessary funds and also to superintend the construction and operation of the canal.

This important step in the canal movement was followed in 1910 by action taken by the Legislatures of Pennsylvania, Ohio, and West Virginia, all of which passed laws authorizing counties in the States bordering on the canal, or contiguous to the lake and navigable river termini of the canal, to issue bonds for its construction.



ORE-LADEN LAKE STEAMERS AWAITING PASSAGE THROUGH THE ST. MARY'S FALLS CANAL

Doubtless the dissatisfaction of many Pittsburgh interests with the railroad freight rates to the lake has had much to do with the continued demand for the opening of the canal. While the Pittsburgh rate is as low as, or lower than, the rates from the several West Virginia districts, the ton-mile rate is considerably higher than from other important fields. That this is a factor in the movement is shown by the following figures prepared and published by those who are interested in the canal proposition:

	Rail Rate Per Ton	Toll Canal Rate Per Ton	Free Canal Rate Per Ton	Toll Canal Saving Per Ton	Free Canal Saving Per Ton
Ore	$1.25	$0.60	$0.25	$0.65	$1.00
Coal	.97	.49	.19	.48	.78
Average	$1.11	$0.54	$0.22	$0.56	$0.89

An idea of the extent of the tonnage which the canal would accommodate is given by the following existing tonnage movement:

	Total Tons	Iron Ore	Soft Coal
1906	75,609,649	36,872,508	14,488,240
1907	83,498,171	40,727,972	17,445,540
1908	60,518,024	24,939,185	14,681,911
1909	80,974,605	40,732,677	15,652,293
1910	86,732,316	41,517,641	18,406,469

Under the latest proposition for the opening of the canal, the United States Government is asked only to supervise the construction; while it is proposed that the counties interested shall issue bonds, the part to be borne by each individual county to be based upon the estimated benefit which it will derive from the improvement. The question of canal depth has been debated just as the question of dimensions of canals was debated three-quarters of a century ago. The private interests that have fathered the cause of the canal advocate a 12-foot depth, but they are met, as were the early canal pioneers, by arguments on the part of those who would restrict it to nine feet.

The total cost of a 12-foot depth, which would accommodate 2000-ton barges, is $60,000,000. It is estimated that the canal would have traffic amounting to 15,000,000 tons a year before it had been in operation four years. It is further estimated that on this tonnage the canal could make rates that would easily carry the interest on the bond issue required for its construction, and that these rates would mean a substantial saving to shippers.

As reasons why the National Government should co-operate in the construction of the canal, the following have been urged: First, the canal

forms the link connecting the Great Lakes and tributary canals with the interior river system of the country directly at the point where there is an existing tonnage movement larger than in any similar area in the world. Second, the Panama Canal and the Erie Canal across New York State are soon to be opened. The Atlantic and Pacific Oceans, Gulf of Mexico, Great Lakes, and interior river systems of the country will be

JUNCTION OF ALLEGHENY AND MONONGAHELA RIVERS

united, and an unbroken waterway connection between twenty-seven States and Canada, providing competitive rail and water rates for the benefit of interstate and foreign commerce will be established.

The fact that the Federal Government is now committed to the scheme of improvement of canals inside the Atlantic seaboard, and that government engineers have made a favorable report on the feasibility of a cut across New Jersey and a deep-draught canal across the Delaware peninsula has lent new courage to those who have urged the Lake Erie and Ohio River Ship Canal. It is pointed out that the classes of freight that move between Pittsburgh, New Castle, and the Lakes are classes that may profitably be transported in barges. It is urged that if there is one district in the country where a deep barge canal would prove

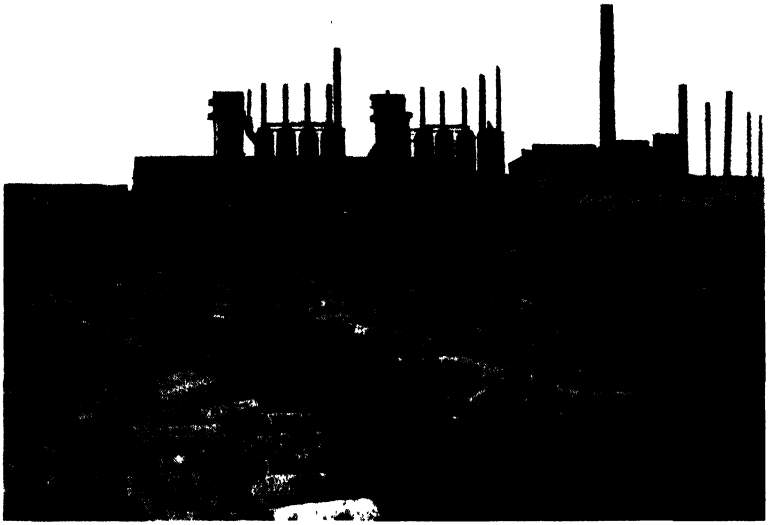
its practicability it is in this territory, where an enormous amount of ore moves southward from the Great Lakes, passing, as it moves, the northbound coal from the western Pennsylvania mines.

The most hopeful step thus far taken toward the beginning of this project, is the report submitted by the National Waterways Commission, which recommends that the National Government co-operate in the work.

The commission is of the opinion that the main question to be considered in reaching a conclusion as to the feasibility of the proposed canal is what part of this traffic it can reasonably be expected to obtain in competition with the railways now operating in the same territory. The calculations made in 1905 give 3,000,000 tons as the probable traffic for the first year of operation, 22,500,000 for the fifth year, and 38,000,000 for the tenth year. There are a number of considerations, the commission believes, which would indicate that these estimates are probably too high. It declares that in order to successfully compete with the railways the canal must offer cheaper transportation, except when there is an excess of traffic. The cost of transportation on the proposed canal is estimated at 1.58 mills per ton-mile, which, with the tolls proposed to be charged, would make the total cost about 3 mills per ton-mile. This, the commission holds, would undoubtedly give the canal the required advantage over the competing railways if the present rates, which are generally considered to be high, amounting to about 8.5 mills per ton-mile for iron ore and 6.8 mills per ton-mile for coal, were maintained after the canal was opened. "It may be confidently expected, however," the commission says, "that the railroads will make substantial reductions from the present high rates whenever they are not operating to their full capacity, in an effort to keep traffic from being diverted to the waterway, and every reduction in their rates will lessen the advantages of the canal. Some idea of the point below which the railroads could not profitably reduce their rates is shown by the fact that the cost of shipping ore on the Bessemer and Lake Erie Railroad, which is owned by the United States Steel Corporation and operated as a bulk freight road from Pittsburgh to Conneaut on the Lake, is stated to be about 2.8 mills per ton-mile, and the cost of hauling coal in full-train loads on the Pittsburgh and Lake Erie Railroad, which the canal would parallel for most of its length, according to estimates made by Frank Lyon, attorney for the Interstate Commerce Commission, is less than 2 mills per ton-mile.

"Several cases involving the fairness of these coal rates from the Pittsburgh district to the Lake Erie ports have recently been considered

by the Interstate Commerce Commission and reductions amounting to 10 cents a ton ordered. The complaint investigated was that these rates were unreasonably high in comparison with the West Virginia coal rates, some of which average less than 3 mills per ton-mile. The railways competing with the proposed canal will doubtless be restrained from making excessive reductions in their rates by the provision of the Mann-



PIG-IRON STOREYARD

Elkins Act of 1910, which prohibits railroads lowering their rates in competition with a waterway from raising them again until after hearing by the Interstate Commerce Commission. This provision was inserted in accordance with the recommendation of the National Waterways Commission in its preliminary report, the purpose of which was to prevent the elimination of water competition by unfair means."

In view of the great benefits which would result from the construction of this waterway, the commission believes that the Federal Government is justified in co-operating with the localities which are to furnish the funds, to the extent of building the approaches to the canal and of lending them the Army engineers to perform the engineering work necessary for its construction. The commission accordingly recommends that

when $10,000,000 is available in cash, and bonds to the amount of $50,000,000, or as much more as is necessary in the opinion of the Secretary of War to insure completion of the canal, have been authorized, and the legality of such bonds has been certified by competent legal authority, the Secretary of War shall direct the Chief of Engineers to detail, without charge for services, such officers from the Corps of Engineers as he shall deem necessary to perform the engineering work necessary for the construction of the proposed canal. The commission further recommends that when the work of constructing the canal has actually begun, Congress, if satisfied that it will be completed, shall appropriate the funds necessary for an adequate harbor in Indian Creek at the Lake Erie end, and for the necessary improvement of the Ohio River in the Pittsburgh district, the same to be completed by the time the canal shall be ready for operation. It is held, however, that the Government should not be required to purchase any land in making these improvements.

The plan of co-operation proposed by the commission is intended to leave the canal essentially a local enterprise, and the recommendations for the co-operation of the Federal Government in constructing this waterway are not, the commission states, to be construed as committing or obligating the Government to assume financial responsibility for construction, maintenance, or operation.

THE INDUSTRIES OF PENNSYLVANIA

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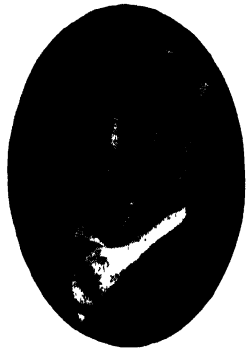

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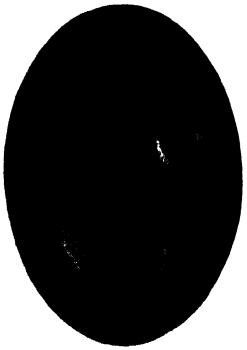
Chairman Committee on Local Excursions



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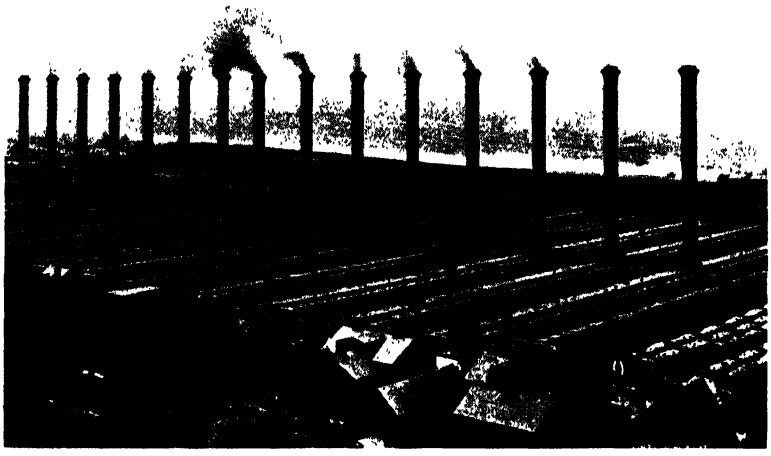
CLINTON ROGERS WOODRUFF
Vice-Chairman Press Committee

An Industrial Commonwealth

AMONG the States of the Union, Pennsylvania is the oldest and youngest of industrial Commonwealths. Oldest, in that within its borders more branches of manufacture have been carried forward generation after generation, than in any other State. Youngest in that, with the vigor of youth, it is putting forth each year something new in the field of industry. Here are the oldest industries in the country. Here,



IMMENSE COKE OVENS, JONES & LAUGHLIN COMPANY, PITTSBURGH

too, are new, vigorous branches of industrial endeavor that have sprung up within a decade. While the development of the steel industry is the greatest single chapter in the industrial history of Pennsylvania, it is but one of many that make this history the most remarkable of that of the western hemisphere. Statistics show that there are in Pennsylvania 27,563 industrial establishments, operating with an aggregate capital of

$2,749,006,000, and turning out products, in the last census year, in excess of $2,626,000,000.

A comparison of the statistics for Pennsylvania with those for the other States shows its industrial importance. There was but one other State—New York—that exceeded it in total value of production, and Pennsylvania and New York were the only two that went beyond the

HOT RAILS ON THE COOLING FRAMES

two-billion mark. Illinois, however, was close to that mark, while Massachusetts ranked fourth. In the amount of capital New York and Pennsylvania are about the same. In the amount of power used Pennsylvania leads, with 2,921,547 horsepower, followed by New York, with a million less, or 1,997,669. It will thus be seen that the industries of Pennsylvania are of such a nature as to require more power than those of New York. This is due largely to the fact that Pennsylvania is the most important State in the metal industries. In diversity of manufacture Pennsylvania is excelled by none of the States.

The summary for the State shows increases in all the items for the census of 1909 as compared with the census of 1904. There was a substantial increase in the number of manufacturing establishments,

which advanced from 23,495 to 27,563, an increase of 17 per cent. The following table shows the increases:

	1904	1909	Percentage of Increase
Number of establishments	23,495	27,563	17
Capital	$1,995,837,000	$2,749,006,000	38
Cost of materials	$1,142,943,000	$1,582,560,000	38
Salaries and wages	$441,230,000	$566,524,000	28
Miscellaneous expenses	$167,267,000	$206,301,000	23
Value of products	$1,955,551,000	$2,626,742,000	34
Value added by manufacture	$812,608,000	$1,044,182,000	28
Officials and clerks	66,081	94,885	44
Wage earners	763,282	877,543	15

A ROW OF COKE OVENS NEAR PITTSBURGH

These figures are for "establishments" as defined by the thirteenth census as follows: One or more factories, mills, or plants owned, controlled, or operated by a person, partnership, corporation, or other owner located in the same town or city, and for which one set of books of account is kept.

The thirteenth census, like that of the year 1904, differs from the census of 1900, with reference to manufactures, in that the two later censuses excluded the hand and the building trades and the neighborhood industries, and took account only of establishments conducted under the factory system. The totals given for Pennsylvania do not include steam laundries. Of these there were 385, having a capital of $6,685,000. The cost of materials used was $1,450,000 and the value of products $8,332,000; the average number of wage-earners employed during the year, 9639.

According to the figures of the State Department of Internal Affairs there were 151 different branches of manufacture that reported to that

department for the year 1910. While this differs somewhat from the census figures and cannot be taken as showing all of the industries in the Commonwealth, it gives a fairly accurate understanding of the extent of the various lines of manufacture and the number of establishments. Of these varied lines of manufacture, each of the following had a production valued in excess of $10,000,000:

Character of Industries	Number of Establishments Considered	Market Value of Production	Number of Wage Earners
Anthracite coal mined	115	$157,123,658	165,634
Bituminous coal	874	146,353,044	184,083
Iron and steel—rolled into finished form.	130	487,416,059	130,324
Iron and steel—ingots and castings	33	22,145,148	11,342
Pig iron	64	178,368,577	16,778
Tin plate	20	34,955,505	10,701
Boilers, tanks and vats	41	10,330,556	3,455
Boots and shoes	109	20,052,795	10,690
Carpets and rugs	79	27,111,459	12,491
Cars and car wheels	20	75,177,349	18,542
Castings	84	12,869,839	7,263
Cement	26	20,135,069	10,924
Cotton goods	74	33,834,547	12,130
Confectionery	60	18,624,144	6,635
Drugs and chemicals	39	25,584,262	5,470
Engines and boilers	31	17,969,074	5,835
Electrical supplies	23	32,085,514	12,261
Furniture	102	19,086,048	7,985
Glass, plate	16	10,211,661	5,775
Hats	39	15,455,511	8,316
Hosiery	188	29,896,650	24,777
Iron and steel bridges	9	21,629,383	5,820
Leather—enameled and glazed kid	17	25,906,171	5,261
Leather—sole	35	14,037,557	2,336
Machinery	137	35,940,371	16,716
Machine tools	52	12,359,000	4,975
Oil—crude and refined	31	50,209,958	5,770
Paints, white lead, etc.	27	17,362,834	1,826
Paper mills	36	21,771,362	6,451
Pipes and tubing	25	22,356,370	6,700
Railroad supplies	14	22,148,032	6,509
Shirts	96	11,541,203	9,046
Silk	185	59,661,962	33,505
Steam and electric locomotives	11	49,633,229	36,214
Sugar refining	2	48,915,778	1,435
Tanneries	66	41,255,205	5,880
Woolen goods	42	10,488,593	4,711
Yarn	86	35,074,763	12,470

It is to be noted that this tabulation makes no mention of the printing business, which is rated among the first ten industries in value of production. It is natural that a State which was the home of Benjamin Franklin should excel in the character of its printing, and in this industry Pennsylvania takes high rank both in volume and quality of product.

The other lines of manufacture, with the aggregate production (1909) in each line follows:

Anthracite coal washed	$3,096,050
Agricultural implements	3,822,194
Alcohol, acetate of lime, charcoal, etc	3,762,511
Aluminum	6,841,792
Asbestos product	4,337,354
Automobiles	5,118,764
Awnings	189,013
Axes and edge tools	1,890,730
Axles and springs	4,982,472
Barrels and kegs	3,923,078
Beds, bed springs and cots	1,792,271
Blankets, flannels, etc.	5,357,082
Bobbins and mill supplies	518,137
Bolts, nuts and rivets	5,866,058
Braids, tapes and bindings	5,284,882
Brass castings	6,877,975
Brooms	657,608
Buttons, thread, hooks and eyes	2,841,051
Caskets and undertaker's supplies	2,519,439
Chains	1,555,785
Chandeliers and gas fixtures	1,525,491
Cigar boxes	1,651,726
Cold rolled steel pulleys and shafting	9,949,177
Copper and bronze castings	2,789,864
Cordage, ropes and twine	5,264,763
Cork	6,152,768
Corsets	747,315
Cutlery	1,284,976
Curtains	6,943,088
Curled hair and glue	5,721,277
Dental, surgical and optical supplies	3,700,587
Dyeing, bleaching and finishing	7,429,396
Embroideries and handkerchiefs	2,707,500
Enamel and electric signs	593,305
Enamel and galvanized ware	917,863
Fence railings and wire goods	5,269,040
Fertilizers	5,025,143
Foundries	9,461,662
Gas and gasoline engines	5,072,996
Gas mantles	234,112
Gas meters	4,098,098
Glass, cut	1,545,872
Glass bottles	9,438,955
Glass, decorative	2,194,051
Glass, tableware	4,129,206
Glass, windows	7,641,979
Glass, stained	194,023
Glass, sand	797,769
Gloves and mittens	722,190
Hair cloth	1,312,429
Hats and caps	617,519
Hardware specialties	7,511,200
Iron and steel forgings	5,530 663
Iron and sheet metal	4,762,511

Knit goods	$1,154,644
Lace goods	2,310,631
Ladies' skirts	3,284,346
Lamps and chimneys	2,688,952
Leather, miscellaneous	2,369,341
Leather, harness	1,056,057
Mattresses	668,973
Mantles, tile and brick	1,003,992
Mine supplies	2,391,587
Mine squibs	171,341
Musical instruments	1,544,629
Neckwear	2,092,878
Oil cloth and window shades	4,810,519
Oil well supplies	2,171,022
Overalls	797,525
Packing boxes and patterns	4,676,784
Paper bags and shipping tags	1,619,437
Paper boxes	6,446,424
Pickles, preserves and canned goods	7,811,377
Picture frames and veneers	594,508
Planing mills, building material	7,230,778
Plumber's supplies	4,225,110
Pottery dishes and porcelain ware	3,550,219
Powder and high explosives	5,423,376
Pumps and valves	5,768,956
Radiators and steam fittings	3,630,639
Refrigerators	2,855,255
Regalias, flags and sporting goods	3,240,785
Rubber goods	5,166,805
Safes, vaults and locks	2,119,366
Saws and files	1,609,031
Scales and separators	764,828
Shirts and shirtwaists	6,392,467
Shovels, scoops and spades	1,367,665
Shoddy and waste	1,147,115
Showcases and store fixtures	190,519
Skylights and cornices	1,357,095
Slate	3,842,362
Soap	8,973,649
Stationery and engraving	5,504,865
Steamships and launches	6,913,697
Stoves, heaters and ranges	8,697,023
Structural iron	8,265,880
Suspenders	2,088,321
Terra cotta pipe, etc.	750,885
Tin ware and stamped ware	3,608,630
Towels	1,639,136
Trunks and suit cases	1,639,284
Turbine and water wheels	1,668,379
Typewriters and supplies	2,569,756
Umbrellas and parasols	4,855,725
Underwear	5,749,886
Upholstery	6,532,051
Ventilators, elevators and fire escapes	2,267,932
Wagons and carriages	6,993,022
Wall paper	3,625,458
Watches, clocks and jewelry	3,798,180
Wood novelties	2,292,861

The State's Steel-Making History

FROM the raw material—the iron ore which comes into Pennsylvania from the Lake Superior ranges, from Cuba, from Sweden, and from other iron districts—the first step toward the production of finished products is, of course, the making of pig iron. While Pennsylvania still provides a part of the ore that supplies the many blast furnaces that turn out the pig iron supply, this is to-day a small part of the total amount of ore handled by the furnaces within the State.

In the early days, as has been stated, the smelting of ore was accomplished with charcoal, and in those days proximity to forests and to ore were the requisites for the production of iron. Then came the day when anthracite coal was discovered and when it was ascertained that it could be used in the smelting of ore. This caused the blast-furnace development in the Lehigh region. But when coke made from bituminous coal was found to be the best blast-furnace fuel, the industry speedily moved farther and farther west into the bituminous fields. With the decline of the Lehigh Valley in this industry has come the great advance of the Pittsburgh district.

The total production of pig iron in the United States in 1910 was 27,303,567 tons, of the value of $425,115,235; and of this amount, Pennsylvania alone produced 11,272,323 tons of a value of $180,695,338. The second State in point of production—Ohio—produced less than half the amount of Pennsylvania. Not only was its production the greatest, but the increase, from 1909 to 1910, was greater than that of any other State in the Union. In 1910 Pennsylvania had 164 blast furnaces, which was more than twice the number in Ohio, three times the number in Alabama, and six times the number in any other State. The increase between December 31, 1909, and December 31, 1910, was 61. The number of blast-furnace stacks in the State, 172, is almost double the number in Ohio.

Following the process of pig iron production comes the making of steel by differing processes, and from these initial steps the material moves onward into the thousands of manufacturing plants in which it is shaped and formed into the multitude of iron and steel products that comprise Pennsylvania's varied and extensive output.

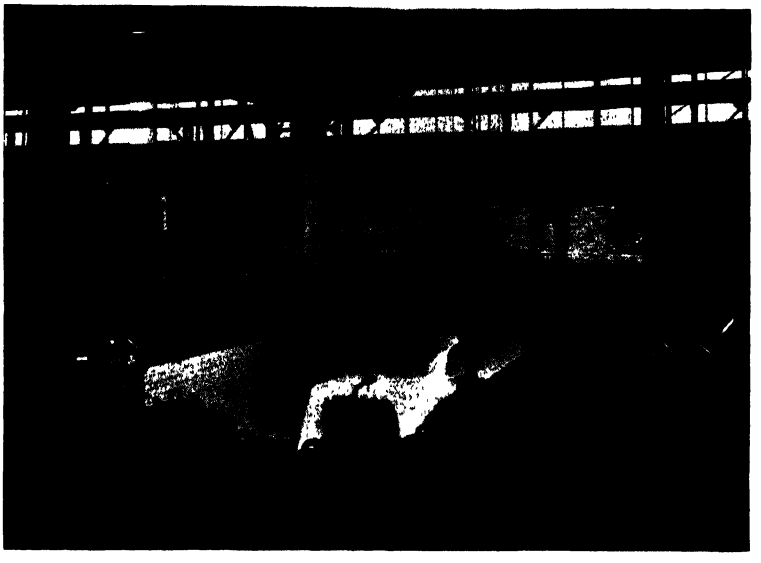
Experiments in the making of blister steel were carried on in New England as early as 1655, more seriously in Connecticut in 1740, in Massachusetts in 1750, in New York State in 1776. The industry on this side of the ocean was, however, discouraged by the British Government, on the ground that it competed with the British industry. In 1805 Pennsylvania had two steel furnaces producing annually 150 tons. In 1810 the

CHARGING AN OPEN-HEARTH STEEL FURNACE

whole country produced 917 tons of steel, 531 coming from five Pennsylvania steel furnaces. The industry died down for many reasons, principally for lack of proper crucibles.

Prior to 1860 this country relied mainly upon England for its steel supply. The manufacture of crucible steel had made but slow progress down to that time. The credit of placing this industry on a firm basis is given to Dr. Curtis G. Hussey, of Pittsburgh, whose firm successfully made crucible steel of the best quality as a regular product in 1860. Bessemer steel was first made in this country in an experimental way at Wyandotte, Mich., in 1864, by a company made up largely of Pennsylvanians. Three years later, the first Bessemer steel to be made in this State was turned out at the Steelton plant of the Pennsylvania Steel Company.

In the Bessemer process of steel manufacture streams of cold air are forced under pressure into a vessel called a converter, which has been partly filled with melted cast iron. In this operation the oxygen of the air combines with and eliminates the carbon and silicon in the iron. The product is thus decarburized and desiliconized. But, as a certain amount of carbon is always required to produce steel, a definite quantity of man-



POURING OPEN-HEARTH STEEL INTO LADLE

ganiferous pig iron—spiegeleisen or ferro-manganese—is added to the contents while they are still in a state of fusion. By this addition the required amount of carbon is obtained, and the manganese combines with and liberates the oxygen that has united with the iron during the blast. The quality of temper of the Bessemer steel thus obtained depends upon the character and proportions of the materials used.

A distinguishing feature of the Bessemer process consists in the entire absence of any fuel whatever in converting the already melted cast iron into steel. The carbon and silicon in the iron combines with the oxygen of the atmospheric blast and produces an intensely high temperature. The Bessemer converter holds from 5 to 20 tons. The charge of cast iron which it receives preliminary to a conversion or blow is either supplied directly from a blast furnace or from a cupola in which pig iron is melted.

A Bessemer converter, weighing with its contents from 20 to 40 tons, is moved on its axis by machinery controlled by the touch of workmen. It receives, in response to the same touch, a blast so powerful that every particle of its many tons of metallic contents is heated to the highest temperature known in the mechanic arts.

In the development of the Bessemer steel industry Pennsylvania has been far ahead of the other States. Its production of Bessemer ingots and castings has decreased as its production of open-hearth ingots and castings has increased. The Bessemer production of the State in 1906 was 4,827,725 tons, and in that year it easily led all the States. In 1910 the production of the State was 2,975,750 tons, and it was led by Ohio.

The open-hearth process of steel manufacture, of which the Siemens-Martin furnace is the most popular type, consists in melting pig iron in a large dish-shaped vessel, or reverberatory furnace, and afterward decarburizing it by adding wrought iron, steel scrap, or iron ore. Deficiency of carbon is supplied, as in the Bessemer process, by the application of spiegeleisen or ferro-manganese. In this process the steel is made with any percentage of carbon that may be desired. The quantity of steel made at one operation, or heat, is from 5 to 35 tons.

The open-hearth process produces as large masses of steel as the Bessemer process, but is much slower in its operation. It possesses, however, the advantage over the Bessemer process that the melted mixture may be indefinitely kept in a state of fusion until experiments with small portions determine the exact conditions necessary to produce a required quality of steel.

While both processes may be combined with existing rolling mills or crucible steel works, the open-hearth process can perhaps be most economically added to such establishments. This is one cause of its increasing popularity. The open-hearth process is especially adapted to the utilization of the scrap steel and rail ends which accumulate at Bessemer steel works. Naturally, therefore, many open-hearth furnaces have been built in connection with these works, both in Europe and in the United States. Another advantage of the process is its adaptability to the remelting of worn-out steel rails for the production of steel in other forms. A popular use of the open-hearth process in both Europe and America is the production of steel plates for boilers and fire-boxes. On both continents open-hearth steel is also largely used as a substitute for iron in shipbuilding and bridge-building. It is also rapidly coming into use in all countries in the manufacture of all kinds of tools, and generally as a com-

petitor of wrought iron and other kinds of steel. These two processes, Bessemer and open-hearth, have increased the world's production of steel more than 100-fold in the last thirty-five years.

Steel was first made in Pennsylvania by the open-hearth process in 1871-72, and the advance in this State was very rapid. In 1910 the production of open-hearth steel ingots and castings reached a total of

BESSEMER CONVERTER, DUQUESNE STEEL WORKS, CARNEGIE STEEL COMPANY

10,153,816 tons, while Ohio, the State whose production was next largest, produced but 1,733,409 tons. In that year Pennsylvania's production of both Bessemer and open-hearth steel was more than two and one-half times that of Ohio, the State which stood next in the list.

The manufacture of crucible steel began in this country in 1832, in Cincinnati, and the product competed seriously in this country with Sheffield steel. Owing to tariff reduction during the administration of President Jackson, the company failed and the industry languished for a number of years. In 1850 Pennsylvania had 13 steel plants with a product of 6078 tons. After the increase of tariff at the beginning of

Lincoln's administration in 1861 the industry was largely extended, especially for edge tools, but this method could not compete with Bessemer or open-hearth processes in the wider applications of steel.

The first steel rails produced in the United States in commercial quantities were rolled by Cambria Iron Company in August, 1867, from ingots made by the Pennsylvania Steel Works. To-day, iron rails have been virtually supplanted on railroads in this country by steel rails, and in the history of this development the name of Andrew Carnegie has an important place. Mr. Carnegie saw that the day of the steel rail was sure to come, and he made his preparations accordingly. When the day came that American railroads were forced to make the change, the Carnegie plant had been so developed that he was able to produce at lower cost and to undersell competitors. The first 30-foot rails rolled in this country were produced in 1855, at the Cambria Iron Works. In 1875 the Edgar Thomson Steel Works, of the Carnegie plant, rolled the first 60-foot rails. The steel-rail business of the country to-day centers at Pittsburgh, though other Pennsylvania works bear an important part in the total production.

The United States Steel Corporation's research work in the electric steel-making process is being conducted at the Carnegie company's metallurgical laboratories at Homestead, under the guidance of Dr. John H. Unger, chief of metallurgical staff of the corporation. Since February 10, 1910, the corporation has been making steel in a 15-ton electric furnace at the Homestead works—the largest electric steel refining furnace in commercial operation in this country.

The Steel Corporation has the exclusive rights in this country to the Paul Heroult French process of electrically refining steel, which is more practicable for installation in American plants, with their low blast furnace costs, than are the processes in use in the electric steel works in Sweden, Norway and Germany. In 1911 the Crucible Steel Company of America secured a permit from the Steel Corporation to operate electric furnaces under the Heroult patent, and the first installation was made at the Crucible Company's Harrison, N. J., plant. It was originally planned to make a second installation at the Park plant of the Crucible Company, in Pittsburgh, but this project is in abeyance pending the completion of the new open-hearth plant the company is building at Midland, Pa., on the Ohio River, 20 miles below Pittsburgh, where its crude product operations will be centralized, and where it is designed to undertake the electric refining of steel on a large scale. The electric steel process, as utilized in Sweden, does not accommodate itself

to American practice, inasmuch as it contemplates smaller units, and has not yet been developed to operate on the heavy tonnage basis which the American industry has reached. Recent investigations by steel works chemists, however, have developed properties in steel after it has been put through a double-refining process by the use of, first, the open-hearth, and then the electric furnace, that suggest the possibilities of the product

POURING OPEN-HEARTH STEEL INTO MOLDS

being used for high-class rail manufacture. Such a solution of the present steel rail problem on American railroads is being discussed by American steel works engineers. The Firth-Sterling Steel Company, with works at McKeesport, has had a 2½-ton Heroult electric furnace in commercial operation since 1910.

As illustrative of the position of Pennsylvania in the steel industries, it is noteworthy that the only armor plate for battleships made in the United States is produced within the borders of the Commonwealth. John Fritz, one of the ablest of Pennsylvania's iron-masters, was the

first to make armor plate in this country. This was at the Bethlehem works. For some time, Bethlehem and the Carnegie Company had this branch of manufacture to themselves, but after a few years, the Midvale Steel Works successfully invaded the field. Armor plate has been made not only for the warships of the United States Navy, but also for those of various foreign countries.

CHARGING A BESSEMER CONVERTER

Recent years have seen, in both ends of the State, a notable development in the introduction into the field of alloy steel, of the metal vanadium. While commercially a new metal, vanadium was discovered a century ago in some of the Swedish iron ores. Even up to the end of the last century it was considered as one of the rare metals. With the opening of the twentieth century researches as to the effect of vanadium in steel showed such results as to immediately engage the attention of metallurgists, and to arouse interest in explorations for ores of vanadium.

Engineers of the American Vanadium Company in 1905 discovered a large deposit of rich vanadium ore in the Andes of Peru. This deposit is unique in that the vanadium occurs in a previously unknown mineral,

a sulphide of vanadium. The discovery of this deposit at once made vanadium available in quantities sufficient to meet the commercial requirements of the steel industry, and insured a large supply for future needs. The ore, after being mined, is roasted to remove most of the sulphur which it contains. It is then transported in sacks, by steamer around Cape Horn to New York, and then by railroad to the plant of the Ameri-

BLOWING A BESSEMER CONVERTER

can Vanadium Company at Bridgeville, near Pittsburgh. Here the ores are worked, and the vanadium reduced in the form of an alloy with iron, known as ferro-vanadium, which contains about 35 per cent. vanadium.

The working of the ore involves a number of chemical extraction processes to separate the vanadium from the other minerals. The strong affinity of vanadium for carbon makes it impossible to produce ferro-vanadium with carbon as a reducing agent without a large percentage of carbon in the finished alloy. As ferro-vanadium containing carbon is not desirable, it is necessary to reduce the oxide of vanadium by a process that will give an alloy as free as possible from carbon. The production of carbon-free ferro-vanadium is accomplished by means of an aluminum reduction process, operating by combustion of metallic aluminum.

An idea of the growth of the application of vanadium to the iron and steel industry is given by the statement that in 1906 the total production of vanadium steel amounted to only 800 tons, while in 1911 the tonnage of steel into which vanadium entered was over 50,000 tons, with the tonnage for the year 1912 estimated at 100,000 tons. The principal applications of vanadium in the manufacture of steel have been thus far in the manufacture of high-speed tool steel. The use of chrome-vanadium, nickel-vanadium, and nickel-chrome-vanadium steels is to-day general in the automobile industry.

The Primos Chemical Company, of Primos, Delaware County, has a plant at Vanadium, Col., for the extraction of vanadium, a tungsten ore concentrating plant at Lakewood, Col., and a reduction plant at Primos. It controls 5000 acres of tungsten and vanadium-bearing land. The business was established in 1888, and was developed by those who are still the sole owners.

The chief products manufactured are tungsten, molybdenum, and vanadium, which are used largely in the manufacture of tool steels, magnet steels, armament, automobiles, and in warships and other vessels. These metals and alloys are used in armor plate, deck plates, crank shafts, and in many parts of the machinery requiring steel of high tensile strength and resistance to shock. Tungsten, owing to its extremely high melting point, is used in the manufacture of filaments for incandescent lamps, and also in the manufacture of some of the newer arc lamps.

The Steel Industry

LEADING the steel works of the State in point of extent of output are those of the Carnegie Steel Company, at Pittsburgh, which have aptly been termed "the backbone of the United States Steel Corporation." The Carnegie works furnish to the big corporation the steel, in billet or other semi-finished form, for nearly one-half of its finished product, including practically all the steel used by the American Sheet and Tin Plate Company, the American Bridge Company, the steel hoop mills, axle works, and other scattering subsidiaries. It boasts the largest output of steel of any single company in the world.

Figures for the steel output of the Carnegie plants are not given separately in United States Steel Corporation reports, but its 22 rolling mills and steel works were rated two years ago at 4,550,000 tons of Bessemer ingots and over 6,000,000 tons of open-hearth ingots annually. Its Edgar Thomson rail mill, for instance, is rated at 975,000 tons a year; its Homestead Steel Works will produce in excess of 3,200,000 tons of steel products a year.

The Homestead plant of the company is supplied with molten pig iron from the "Carrie group" of blast furnaces, on the opposite side of the Monongahela River, by a "hot-metal bridge," spanning the river—the iron being conveyed direct to the open-hearth furnaces in ladle cars. The Homestead plant was largely devoted to Bessemer steel until 1904, when the company began changing it over to open hearth, piecemeal. Its output is now entirely open-hearth steel, while that of the Edgar Thomson plant, on the opposite side of the river, is devoted to Bessemer steel. The Homestead plant has 64 basic open-hearth steel furnaces, and the Duquesne plant 32 basic open hearths—the total of 96 furnaces of from 40- to 60-ton capacity representing the largest group of open-hearth furnaces in the world. In addition, the Homestead plant has installed an electric furnace of 15 gross tons. The metallurgical laboratories of the steel corporation are located at Homestead.

The Carnegie Steel Company has 59 blast furnaces, with an annual capacity of 8,450,000 tons of pig iron. The products of its mills as a whole are so varied as to make their listing a difficult matter. It has an

annual capacity of 1,450,000 tons of standard steel rails and 200,000 tons of light rail sections; 1,000,000 tons of structural shapes, most of which are delivered to the American Bridge Company for fabrication into bridges and buildings; 1,400,000 tons of plates, 250,000 tons of car axles, 500,000 tons of hoops and cotton ties, 800,000 tons of merchant bars, concrete reinforcement bars, steel railroad ties, and other specialties; 200,000 tons of iron, brass, and steel castings and about 25,000 tons of finished armor plate. Recently the company has gone into the manufacture of car wheels on a large scale.

Jones & Laughlin Steel Company

The Jones & Laughlin Steel Company is one of the pioneer American concerns, having been founded in Pittsburgh in 1849. It is to-day among the large steel companies of the United States, having an annual tonnage of 2,000,000. The business is still in control of the men who founded it back in the days when Andrew Carnegie was yet a telegraph operator. The company owns its coal, limestone, and iron ore supplies, and controls all processes from mining its raw materials to finishing its products. It has its own fleets of towboats and barges on the Monongahela River for the transport of its coal, and some of the finest ore steamers on the lakes for the transport of its ore. Its ore docks are at Ashtabula, Ohio, from which port it utilizes the Pittsburgh and Lake Erie Railroad in bringing the material to the Pittsburgh district. Many times it has been reported in recent years that the company was preparing to build its own iron ore road over the 125-mile stretch from Ashtabula into Pittsburgh; but, though the survey for such a railroad was made years ago, the project has never been carried further than the preliminary stage.

The company's Pittsburgh works, situated on both sides of the Monongahela River, have an annual capacity of 1,200,000 tons of steel and 1,000,000 tons of finished material. The company has six blast furnaces at its old plants in Pittsburgh, with a rated annual capacity of 1,050,000 tons of pig iron, and four additional furnaces at its newly completed plant at Aliquippa, rated at 700,000 tons a year. The new plant at Aliquippa is the largest single new plant added to the country's iron and steel equipment at one operation in twenty years, with the exception of the United States Steel Corporation's new works at Gary, Ind., and compares favorably with the latter in point of crude metal output. This has a capacity of upward of 800,000 tons of crude steel.

ORE PILES, CAMBRIA STEEL COMPANY, JOHNSTOWN, PA.

GROUP OF LLAMAS IN THE PERUVIAN ANDES LADEN WITH VANADIUM ORE FOR AMERICAN VANADIUM COMPANY, PITTSBURGH

Its finished capacity has not been given an official rating, as the finishing mills are still in process of extension. The principal coke plant is located in Pittsburgh, where 1900 ovens have an annual capacity of 1,330,000 tons of coke. At the Aliquippa plant, 900 more ovens are rated at 480,000 tons of coke a year.

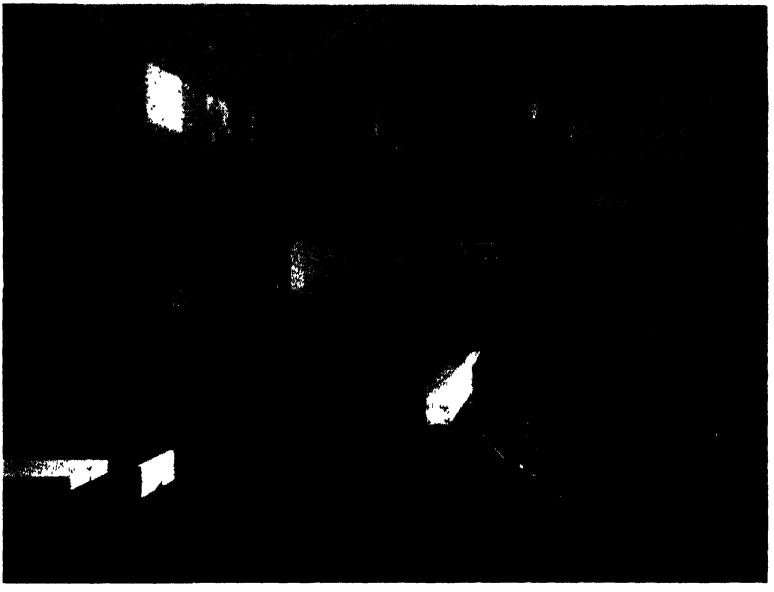
Instead of the type of stationary 40-ton to 60-ton open-hearth steel furnace, so popular in Pittsburgh, the company has, in its recent extensions, adopted almost exclusively the large 200- and 250-ton tilting open-hearth furnaces of the Talbot type. Besides twelve of the 40-ton and 50-ton furnaces of the old type at its Pittsburgh plants, its South Side works contain five 200-ton Talbots and its Aliquippa works six of the large tilting furnaces, each 250 tons. The first steel was made at the new Aliquippa works of the company in January, 1912. The finished product plans for the Aliquippa plant were a matter of considerable conjecture during the building of the primary pig iron units on the new site. The company's first announcement of its finished product plans furnished a surprise in its invasion of the wire and wire nail and tin plate fields.

Among the Jones & Laughlin Company's products are open-hearth and Bessemer steel, steel sheet piling, power transmission machinery, cold rolled steel shafting, rope drives, concrete reinforcing bars, steel wire nails, barbed wire, fence and special screw wire, tinplate, railroad spikes, light rails and connections, steel mine ties, steel barges, structural steel, and chains. Recently the company has gone into the building of steel barges for the inland river trade, especially designed for coal transport. The plain structural material for the lock gate work at the Panama Canal, aggregating between 60,000 and 80,000 tons, was furnished to the contractors, the McClintic-Marshall Construction Company, of Pittsburgh, by the Jones & Laughlin Company.

Pennsylvania Steel Company

The Pennsylvania Steel Company has a plant occupying a frontage of three miles along the Susquehanna, in Steelton, near Harrisburg, and is the oldest company of the kind in the country. It was founded in 1865, and in June, 1867, made the steel from which were rolled the first steel rails produced commercially in this country. The Steelton plant is the largest in central Pennsylvania, employing normally about 7000 men. The Pennsylvania Steel Company, besides the works in Steelton and Lebanon, owns the following: Maryland Steel Company, with works

at Sparrow's Point; Baltimore and Sparrow's Point Railroad Company; Spanish-American Iron Company, operating iron mines in Cuba; and Penn-Mary Coal Company, operating coal mines in Indiana and Cambria Counties. It has a controlling interest in the Cornwall Ore Banks Company and the Cornwall and Lebanon Railroad Company. The leading features of the equipment and natural resources of the Pennsylvania



ROLLING A STEEL BLOOM

Steel Company and its constituent companies are as follows: Coal lands in Pennsylvania; ore properties in Pennsylvania and Cuba; 410 by-product coke ovens, 120 of these being in Steelton; 11 blast furnaces, 5 in Harrisburg and Steelton; 4 pig iron casting machines, 2 in Steelton; 2 complete Bessemer plants with a total of 6 converters, 3 in Steelton; 22 open-hearth furnaces ranging up to 80-ton capacity each, 17 being in Steelton; 9 rolling mills, including slabbing mill, rail mills, merchant mills, etc., 7 in Steelton; steel foundry with 2 open-hearth and additional crucible furnaces making castings up to 30,000 lbs. weight; forge department, with rough finishing equipment. In addition, there are, at Steelton, a large frog and switch department and bridge and construction department. The annual capacity at Steelton is: Pig iron, 340,000 tons; open-

hearth steel, 500,000 tons; Bessemer steel, 360,000 tons; steel rails, slabs, and billets, 500,000 tons; steel castings and forging ingots, 21,000 tons; other products, 300,000 tons; coke, 400,000 tons.

The company controls and operates in Cuba two separate mining properties, one near Santiago on the south coast and one inland from Nipe Bay, on the north coast. These mines are known as the Daiquiri and Mayari groups, respectively. Most of the ore is quarried or blasted out and loaded with steam shovels and transported to crushers and loading piers for shipment to Sparrow's Point. About 1000 men are employed here, and the normal output is from 40,000 to 50,000 tons per month.

The Mayari mines are located on a plateau some 1500 feet above sea level. The ore is transported down two inclined planes, over 10 miles of standard gauge tracks to the town of Felton, situated directly on Nipe Bay. At Felton the ore is fed into rotary kilns and nodulized, pulverized coal being used as a fuel. This process eliminates and collects or agglomerates the fine particles of the ore into pellets or nodules suitable for use in the blast furnace. From the kilns the ore is placed in storage under gantry bridges, equipped with grab buckets for loading into the ship's holds. The normal output of this plant is from 40,000 to 50,000 tons per month, but the mining and handling facilities are capable of caring for a much larger tonnage. The marine and dock departments of the company are at Sparrow's Point. Here all of the Cuban and imported ores are received for both Steelton and local use.

Cambria Steel Company

The Cambria Steel Company has an authorized capital stock of $50,000,000. It leases and operates the plant formerly operated by the Cambria Iron Company. Its general offices and works are located at Johnstown, Pa., about 275 miles west of Philadelphia, and about 79 miles east of Pittsburgh. The manufacturing plants cover approximately 392 acres. The annual capacity of the company is 1,000,000 tons of finished steel. In good times 20,000 names are on its pay-rolls.

The Cambria manufacturing plants consist of 8 blast furnaces, 4 Bessemer converters, 25 open-hearth melting furnaces, 4 blooming and slabbing mills, 25 billet, bar, rail, shape, structural, plate, and wire-rod mills, and extensive shops for the finishing of all kinds of steel products. A recent addition is a complete modern wire mill. These plants, on account of their location, are divided into four sections, and are familiarly known as the Cambria Works, Gautier Works, Franklin

Works and Rod and Wire Plant. At the Franklin Works is located a complete by-product coke-oven plant, consisting of 372 Otto-Hoffman ovens, having an annual capacity of about 600,000 tons of coke. A complete equipment for the recovery from the gas of tar and ammonia is installed. It owns and operates large coal mines and is one of the greatest producers of semi-bituminous coal in the State. Originally using local

ROLLING STEEL RAILS

ores, it now owns large ore mines in the Lake Superior districts and transports the ore across the lakes by its own fleet of ore boats. It has dams capable of supplying 100,000,000 gallons of water daily to the works, one of these, the Quemahoning, being connected to the plant by a pipe line of steel plate 66 inches in diameter, which is 14 miles long. Its own hospital, which is thoroughly modern, was the first industrial hospital established in Pennsylvania. Under its direction the first industrial relief fund in the country was founded in 1864. To this there has been added in recent years a pension fund. Both of these funds are guaranteed by the company. Broad- and narrow-gauge track systems traverse and connect all of the plants completely equipped and operated by the com-

pany's own transportation department. These connect with terminal yards of the Pennsylvania and Baltimore and Ohio Railroads.

This company holds a unique position in the history of the iron and steel industry of the United States in that it is the oldest steel works which has mined and worked its own fuel and ore from the beginning of its operations. With its great natural resources it has been able to make steel on a large scale and enter into successful competition in the markets of the world.

Bethlehem Steel Corporation

The Bethlehem Steel Corporation has made rapid advance under the enterprising management of Charles M. Schwab, one of the recognized captains of the steel industry who were developed by Andrew Carnegie at Pittsburgh. The principal plants are located in the boroughs of South Bethlehem and Northampton Heights, between the Lehigh River on the north and the tracks of the Philadelphia and Reading Railway Company on the south. The plants are more than two miles in length, and from one-quarter to one-half mile in width. They comprise an area of over 500 acres, and include 7 blast furnaces, with a total capacity of 75,000 tons of pig iron per month; 2 open-hearth furnace plants, with a total of 21 furnaces, and a monthly production of 80,000 tons of ingots; a Bessemer converting plant recently placed in operation, with two 20-ton converters, in which the hot metal is first Bessemerized, the melt being completed in the open-hearth furnaces, the combination of the Bessemer and open-hearth processes representing what is known as the duplex process; a crucible steel forging, melting, and cold-drawing plant; iron, steel, and brass foundries; 6 machine shops, the largest of which is 1750 feet long by 180 feet wide; a rail mill, with a capacity of 40,000 tons per month; a structural mill, with a monthly capacity of 40,000 tons; a standard structural mill, with a capacity of 20,000 tons per month; two blooming mills; a shop for the fabrication of structural sections, with a capacity of 5000 tons per month; merchant mills for the production of simple and alloy steel bars and miscellaneous shapes, staybolt iron, file steel, etc.; a press and hammer forge for commercial and government forgings, such as shafting, gun and battleship forgings; an armor-plate forge and a drop forge.

One of the notable advances made by the company is in the production of structural shapes. It owns the rights to a patented process for beams of a design for which there is claimed greater strength than in

standard beams of equal strength. The company owns and operates extensive ore mines located at Firmeza, eighteen miles distant from Santiago, Cuba, as well as ore properties in New York State. In addition ore is received from the Lake regions of the United States, as well as from Sweden.

Midvale Steel Company

The Midvale Steel Company, Philadelphia, has proved itself to be

PLANT OF THE MIDVALE STEEL COMPANY, WAYNE JUNCTION, PHILADELPHIA

one of the most progressive of the steel-making concerns of the State. The business was established in 1866, and the company was incorporated in 1881. The plant at Nicetown, Philadelphia, has steadily grown until it now covers 52 acres. The company has developed a number of new methods, notably in the manufacture of guns, shells, and armor plate. Its output of locomotive tires is extensive.

Lukens Iron and Steel Company

The Lukens Iron and Steel Company, whose mills are at Coatesville, have the record of having turned out the first plate iron made in the

United States. The mills at Coatesville now have an annual capacity of 380,000 tons of plate. In 1907 the company purchased the controlling interest in the Alleghany Ore and Iron Company, which has mines and furnaces in Virginia. The company is a manufacturer of basic, foundry, and special car-wheel pig iron. With the Empire Steel and Iron Company, the Alleghany Ore and Iron Company controls the Victoria Coal and Coke Company, which has coal lands and coke ovens at Caperton, W. Va.

Crucible Steel Company of America

The Crucible Steel Company of America, the largest producer of high-grade crucible and steel tool steel in the country, has eight of its twelve plants located in the Pittsburgh district. Of its annual capacity of approximately 400,000 tons a year of high-grade steel, 80 per cent. is produced in its Pittsburgh plants. The crucible company makes a greater percentage of its steel into finished product than in the early days of the company's existence, and a number of its smaller plants are being made over more and more into finishing mills. Desiring to secure its own raw material rather than purchase it in the open market, the company two years ago absorbed the Midland Steel Company, at Midland, Pa., on the Ohio River, 20 miles from Pittsburgh.

Firth-Sterling and Carbon Steel Companies

The Firth-Sterling Steel Company, with plant at McKeesport, is a heavy producer of high-grade open-hearth and tool steel. In addition to its McKeesport plant, the company has ordnance works situated at Geisboro Manor, near Washington, D. C. The Carbon Steel Company, with works at Pittsburgh, is a large producer of carbon-chrome safe plates, locomotive driving axles, pins and rods, etc., with an annual capacity of about 150,000 tons of high-grade steel. The company's equipment includes eight 50-gross-ton open-hearth furnaces, and its product is largely alloy steels. The company handled a large contract for special alloy castings in connection with the Panama Canal lock construction.

Iron and Steel Products

FROM Pennsylvania iron and steel there are made products of so diversified a range as to include almost every article into which steel and iron may go. The economy that lies in manufacture at the base of supply is the more important where that raw supply is heavy material. The development of these lines of manufacture within the State and close to the base of supplies has been, therefore, entirely logical and natural. Of these lines of production, one to which prominence may be given because of the part it has borne in the general industrial advance of the State, is the making of machine tools.

Machine Tool Making

The wonderful increase in the use of machinery of all kinds which followed the introduction of the steam engine, together with the necessity of substituting iron for wood in the construction of beds and housings of machines and engines, created, at an early period, a demand for proper devices for shaping and cutting the metals of which the machines were composed, more effectively, more accurately, and more cheaply than was possible with the file, the chisel, the saw, and the hand drill which the first makers used. This class of mechanisms, replacing the hand tools of the earlier worker in metals, are usually known as "machine tools," and embrace a large variety of devices for performing various operations in the shaping of metal to desired forms. The earliest made, the most generally useful, and most widely known is the lathe, almost as old, in some crude forms, as the potter's wheel, and almost as well known.

The development of machine tools has been a marvelous growth, and has rendered possible the creation of the vast variety of machines now used in the arts—from those great structures used in the making of steel, the fashioning of ordnance, and the building of ships, through an endless variety of forms, to such delicate devices as the automatic machines which produce for the watchmaker the tiny screws that can only be clearly distinguished with the microscope. Machine tools have made possible the present development of mechanic arts, and the growing

and changing needs of these arts have stimulated the ingenuity of the makers of machine tools.

Abundant iron and fuel, and the character of her people, early developed Pennsylvania as a manufacturing State, and her makers of machinery have kept pace with the needs of the manufacturer in every line. The machine-tool industry of the State first centered chiefly in Philadelphia, and under the influence of a group of strong men the art there early attained national recognition. Philadelphia builders became widely known for the excellence of their product, and were called on to supply much of the equipment of the railroad shops, government arsenals and navy yards, and many manufacturing establishments.

Among the best known of the earlier builders were Wm. Sellers & Co., Bement & Dougherty, and later Ferris & Miles, C. C. Newton, and others. The first mentioned were probably the earliest to adopt the making of machine tools as their chief business, and have operated under their original name, and in control of the same family, for probably a longer period than any other machine-tool builders in the country. The founder of the house began business as a maker of machine tools in Philadelphia in 1848. A State charter was secured in 1886, and the title changed to Wm. Sellers & Co., Incorporated. This house is well and favorably known throughout the mechanical world for originality of design, for excellence of workmanship, for its pioneer work in developing the art of machine-tool building, and for the propagation of sound mechanical ideas. The founder of the house devised the screw-thread system, which is standard in the United States, and he is also well known for his original inventions in developing the planing machine and other tools. The company introduced in America the Gifford injector, for feeding boilers, which has been greatly improved and developed by them. They were also among the first to apply electricity to the operation of traveling cranes, and to meet the demand for tools capable of utilizing the properties of "high-speed" steel.

Heavy Mill Machinery

Pittsburgh is the logical center for the building of heavy iron and steel mill machinery in this country. Among the score or more concerns specializing on this work, probably the largest are the Mesta Machine Company, with works at West Homestead, Pa.; the United Engineering and Foundry Company, which has three plants at Pittsburgh and four at points within a hundred miles of the city proper, and the Mackintosh-

Hemphill Company, with works in Pittsburgh. The designing of rolling mills, building of mills and engines, and construction of general equipment for heavy steel operations is undertaken by all these companies. All have large outputs of castings, rolls, pinions, etc. Single castings weighing over 100 tons are not exceptional in the foundries of these companies.

CRUCIBLE STEEL MELTING FURNACES, CRUCIBLE STEEL COMPANY OF AMERICA

Recently two of these companies mentioned have undertaken the introduction into this country of different types of hydraulic forging presses, which have of late become popular abroad in heavy work. The Mesta Machine Company took over the American rights to the Haniel & Lueg patents, Germany; and the United Engineering and Foundry Company is introducing the hydraulic press made under the Hanley patents, England.

The Mackintosh-Hemphill plant has had more than a century of continued existence. It has designed and built a large portion of the heavy rolling mill machinery for many of the historic plants in this country. The company takes contracts for the complete designing of mills and motive power, and builds mill and blast furnace engines and all types

of mill equipment. Compound reversing engines and blooming mills for the Carnegie steel works at Duquesne and blooming mills and engines for the new Jones & Laughlin steel works at Aliquippa are among this company's recent installations. An idea of the size of the castings which these plants are able to turn out is afforded by the statement made concerning the Mesta company, that the only limit to size and weight of machinery which it manufactures is what the railroads can handle.

Tin and Terne Plate

It is probable that the manufacture of terne plates for roofing originated in Pennsylvania. The word terne signifies dull, or tarnished, and terne plates are thin sheets of iron or steel, which, instead of being dipped in a molten bath of tin, as would be done if tin plates were to be made, are dipped in a bath containing an alloy of tin and lead. While it is possible that such plates were used for roofing purposes prior to 1830, there seems to be no authentic mention of such use before that time. However, in that year, small quantities of lead-coated sheets were made in a shop located on Market Street, Philadelphia, and this is generally accepted as the beginning of the industry of making terne plates for roofing, not only in the United States, but in the world. The plates made in Philadelphia were 10 by 14 inches in size, and were made by dipping imported English tin plates in a bath of molten lead. N. & G. Taylor Company, Philadelphia, to-day an important factor in the tin and terne plate business, says regarding this early Pennsylvania departure: "News of the sale of so novel an article soon found its way across the water, and terne plates commenced to be made there. Prior to that time, zinc sheets were commonly used in Europe for roofing, but the manufacture of terne plates soon became important abroad, as it was in this country. The pioneer enterprise in the Market Street shop was the beginning of one of Pennsylvania's important industries."

About 1858 or 1859, tinning pots were operated by John Grey, manager of Hussey's Copper Works, Pittsburgh, the black plates being obtained from the Sligo Iron Works of Pittsburgh. The sheets made by him were largely used in the manufacture of kitchen ware and other household utensils. These tin plates were probably the first to be both made and tinned in this country.

Among pioneer plants for the combined manufacture of black plates and tin and terne plates in this country were Rogers & Burchfield, of Leechburg, Pa., and the United States Iron and Tin Plate Company, at

Demmler, Pa. The rolling mills for the Leechburg enterprise were erected in the early 70's, and it was in these mills that natural gas was first used as a fuel in the manufacture of iron.

Several of these early concerns in Pennsylvania showed their enterprise by sending men to England for the express purpose of learning the tin plate industry. One or two of these reported that the industry

WASHING TIN PLATE

could not be successfully established in this country under the wage rate then prevailing. None the less, the industry was established and immediately began to threaten the monopoly that English tin plate had so long enjoyed in this country. But this competition brought about a reduction in the price of English tin and terne plate, which made it difficult for American makers to continue. Up to the year 1890, the manufacture of tin and terne plates was continued under the most discouraging conditions, but since that year the growth has been very rapid. Among the Pennsylvania enterprises that were given their first

real impetus in this period were the Demmler Works of the United States Iron and Tin Plate Manufacturing Company; John Hamilton, of Pittsburgh; the Pittsburgh Electro-Plating Company; the Penn Treaty Iron Works, of Philadelphia, and N. & G. Taylor. It was in this period that Pennsylvania established the pre-eminent position in this industry that it has since held.

Foundry Products. Pipe and Tubes

In the casting of iron in its many forms—in the development of the foundry industry, in its scores of branches—Pennsylvania has long maintained an undisputed lead. The handling of heavy material peculiarly requires the most perfect arrangement of plant, so that the product may move, as it were, in a straight line until it is finished. This means a more expeditious movement, avoids rehandling, and the result is economy. In the metal industries of Pennsylvania special attention has been given to this problem, for the solution of it meant the maintenance of lead over competitors. Such perfectly arranged plants as those of the Baldwin Locomotive Works, at Eddystone, and the recently built foundry of the Enterprise Manufacturing Company, at Cornwells, are illustrative of the trend of metal manufacture to-day. Another illustration of this is in the great plants erected for the manufacture of pipe and tube, a branch in which the plants of the State are pre-eminent, not only for volume of output, but also for that scientific arrangement that means maximum productive capacity. The making of pipe, whether cast or wrought, is one of the many industries which to-day demand the most modern arrangement and handling devices. No company in the world has paid more attention to the perfecting of plant than the United States Steel Corporation.

The United States Steel pipe and tube subsidiary, the National Tube Company, has its central plant and laboratories at McKeesport, Pa., twelve miles east of Pittsburgh. The McKeesport plant has a length of a little over one mile, covering about one hundred acres.

At the lower end of the plant are situated the four blast furnaces with their accessories of car dumper, ore bridge, etc., steel plant, blooming and slabbing mills; the slabbing mill being one of the largest in the world, and having the largest electric shear ever built.

The skelp mills are in the center of the plant, four in number—the two mills for the narrower plates being of the continuous-mill construction. The blooms go in at one end, and, without any handling, are received

beyond the shear, cut to length, piled, and ready to deliver to the trucks on their way to the tube- and pipe-mill end.

The tube- and pipe-mill building is approximately 1600 feet long and 500 feet wide, containing in all 23 acres—the largest building under one continuous roof in the world. In this building are 12 lap-weld furnaces, two of the butt-mill furnaces being of the double-length type and able

MANUFACTURING CAST-IRON PIPE, STANDARD CAST-IRON PIPE AND FOUNDRY COMPANY, BRISTOL, PA.

to produce pipe 40 feet in length. This is true also of No. 1 lap weld, which is the only double-length lap-weld mill which has ever been operated. It will produce 40-foot lap-weld pipe from 3-inch to 12-inch, and has been run on even larger sizes.

The McKeesport plant is claimed to be the most perfectly equipped mill in the United States in the matter of safeguards for the protection of employees from accident. The company has expended upward of $400,000 at this one plant in the last three years in specially designed devices to insure the safety of workmen. The figures on fatal accidents have been carefully kept by the management, and although they are not made public in detail, it is known that the ratio of accidents to men

employed and the ratio to ton of output have decreased more than 50 per cent. in three years. The National Tube Company's McKeesport plant is one of the few large steel-works and blast-furnace groups in the country at which Sunday work has been entirely eliminated during the last two years.

Besides the Steel Corporation, whose steel-pipe activities center in Pittsburgh, there are a number of large independent producers of steel pipe, including the Spang-Chalfant Company, with mills at Sharpsburg, Pa., just across the Allegheny River from the city proper. Further west, at the edge of the Pittsburgh district, are the mills of the Republic Iron and Steel Company and the Youngstown Sheet and Tube Company, both at Youngstown, and the La Belle Iron Works Company at Steubenville, Ohio.

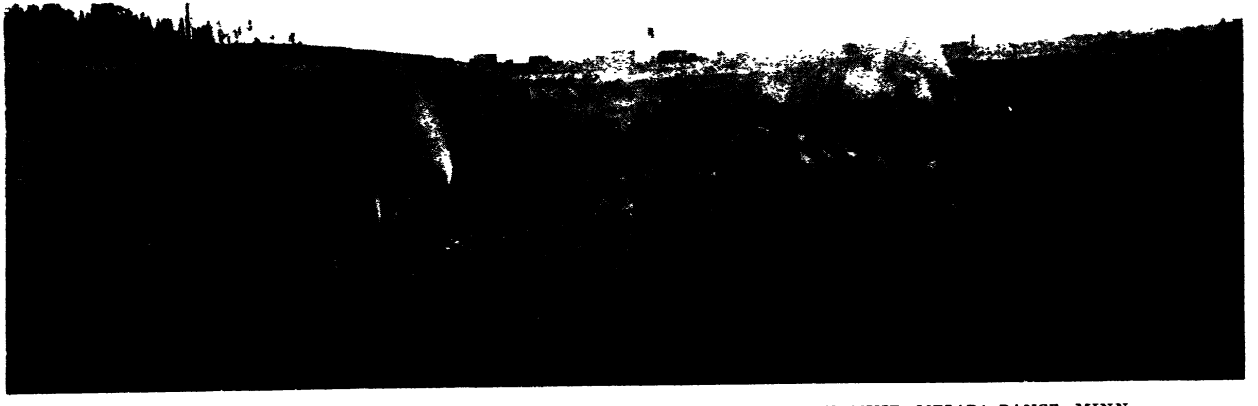
Besides these producers of pipe in the form most commonly known, several concerns in Pittsburgh district make a specialty of large-size riveted pipe, made from heavy steel plates. This is a business all its own. The large-size pipe for penstock work in irrigation enterprises of the Southwest, for the Los Angeles aqueduct, and other heavy water-works construction enterprises has practically all come from the Pittsburgh district.

The Harrisburg Pipe and Pipe Bending Company has a plant in the city of Harrisburg, Pa., covering 22½ acres. It is the largest plant of its kind in the world. The company manufactures the highest grade of special slow-corrosive, wrought-black, and galvanized pipe, open-hearth steel ingots, billets and slabs, coils and bends of iron, brass and copper pipe, boiler-tube skelp, shovel plate, nail plate, sheet bars, seamless steel gas cylinders, feed-water heaters, and pressed-steel shapes for automobile parts.

The mills of A. M. Byers & Co., large manufacturers of iron pipe, are centered at Pittsburgh and Girard, Ohio, this company having the largest equipment for the production of puddled iron—the old-time product, which is still preferred in cases where corrosion must be specially guarded against—in the country.

The Standard Cast Iron Pipe and Foundry Company recently completed an entirely new plant at Bristol, Pa., which is designed for a very large output of cast-iron pipe. Unlike many plants for similar work which have grown from small beginnings and in expanding have been developed in reference to the arrangements already existing, the works are new in every respect and laid out solely with reference to the particular require-

EDGAR THOMSON FURNACES AND STEEL WORKS, CARNEGIE STEEL COMPANY



MINING IRON ORE FOR THE UNITED STATES STEEL CORPORATION, BIWABIK MINE, MESABA RANGE, MINN.

ments of a pipe foundry of large capacity. The land, covering 136 acres, lies on the west bank of the Delaware River.

Car Manufacture

The manufacture of steel cars in the United States had its inception in Pittsburgh in 1897, when the Pressed Steel Car Company undertook an order of 600 cars for the Pittsburgh, Bessemer and Lake Erie Railroad Company. This innovation resulted in the almost complete revolution of transportation methods.

WORKS OF PRESSED-STEEL CAR COMPANY, MC KEES ROCKS, PA.

The Pressed Steel Car Company operates two plants in Pittsburgh, one at McKees Rocks and another in the former city of Allegheny, while the third plant of lighter capacity is located near Chicago. The company has a capacity of 200 cars per day, and employs a force of 10,000 men when running full. The plants of the company occupy a total area of 145 acres, 60 of which are covered with steel and stone buildings of modern construction. The average consumption of the company is 40,000 tons of steel per month, of which 28,000 is steel plate, making

the company unquestionably the largest individual consumers of steel plate in the world.

The steel car and its associate, the steel wheel, have done much to improve and enlarge the carrying capacity of railroads. As late as 1907 a capacity of 100,000 pounds was considered by railroad men to be the maximum capacity that a freight car could carry. Steel freight cars are now being constructed for general use with capacities up to 140,000 pounds, showing a 40 per cent. increase in five years. Probably the most important later development in the manufacture of steel cars has been in its application to passenger service. The great railways of America are gradually substituting their wooden-car passenger equipment with all-steel cars.

The J. G. Brill Company, builder of cars and trucks, was established in 1868 and has occupied its present plant since 1890. The plant is located at Sixty-second and Woodland Avenue, Philadelphia, in a "V" formed by the Pennsylvania and Baltimore and Ohio Railroad lines, and occupies about thirty acres. This is the largest plant of its kind in the world, and, together with the five other plants owned and operated by The J. G. Brill Company in Missouri, Illinois, Ohio, New Jersey, and Massachusetts, has an annual output amounting to $10,000,000. The J. G. Brill Company and its subsidiary companies manufacture both steam and electric cars and trucks and practically all of the items used in their equipment and furnishing, such as car seats, curtains, and truck springs. The trucks manufactured by The J. G. Brill Company cover all conditions of city and interurban railways, and are distinguished from the trucks of other builders by the fact that they are made with solid forged side frames, a process developed by this company. When it is realized that the requirements of city trucks are unusually severe, and the conditions of operation exceedingly complex, owing to the narrow car bodies and large and powerful motors, heavy loads, frequent starts and stops, and frequent rail crossings, it will be understood how great are the difficulties and obstacles which have been overcome and how carefully the development has proceeded. Cars and trucks are built at the Philadelphia plant for all parts of the world where horse, electric, and steam lines are operated.

Hydraulic Turbines

With the new era of hydro-electric utilization of the vast water power in various parts of the United States, there has come a rapid development in the building of hydraulic turbines. Among the plants which have kept

pace with the world's best practice in this branch of manufacture is the I. P. Morris Machine Company, Philadelphia, a company which is owned and operated by the William Cramp & Sons' Ship and Engine Building Company. This is one of the oldest machinery building organizations in the United States, its business having been started in 1828. The first hydraulic turbine work undertaken by the company was the construction of seven turbines of the Geyelin type, for the Fairmount Water Works, Philadelphia. The first unit was installed in 1851, and was among the earliest turbines built in the United States. The building of the turbines for the first installation of the Niagara Falls Power Company was intrusted to the I. P. Morris Company by a Commission of International Engineers, organized for the purpose of considering designs of machinery for utilizing the power of Niagara Falls. This work was so satisfactory that the company was awarded the contract for the units in the station known as Wheelpit No. 2, of the Niagara Falls Power Company, and was awarded the contract for two wheels in the plant of the Canadian Niagara Power Company. A list of the turbine wheels made by the I. P. Morris Company includes many of the largest made in the last ten years for the principal power-developing enterprises of the United States, Mexico, and Canada.

Bridge Building

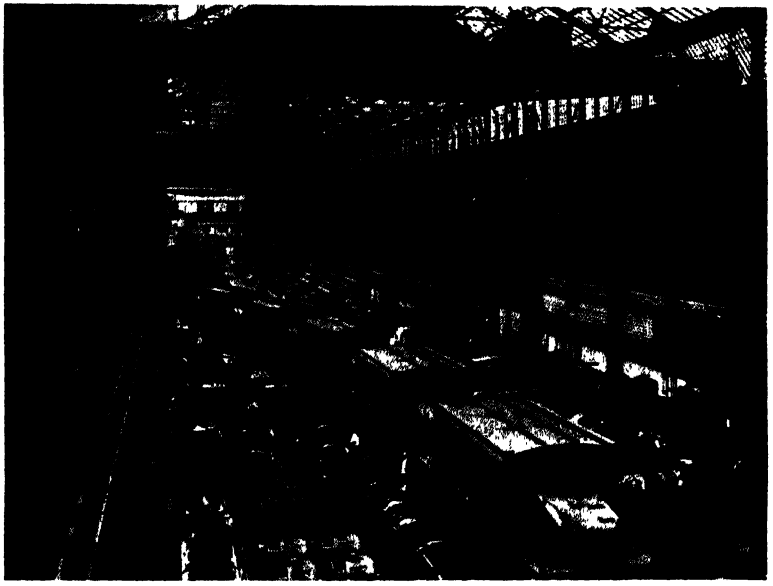
Many of the largest bridges in the world have been turned out from Pennsylvania shops. The Pencoyd Iron Works, Philadelphia, now an underlying plant of the American Bridge Company, has long been successful in the erection of these immense structures. At the present time the American Bridge Company is engaged in putting in place the St. Louis Municipal Bridge, for the city of St. Louis, which will consist of three 668-foot through-pin spans. These are the longest through-pin connected spans of simple type that have ever been built. They carry a double-track railroad, and above that a highway. The main spans are of nickel steel; the trusses are 10 feet deep and 65 feet from high water to clearance line, and about 115 feet from high water to rock, making approximately 290 feet from the top of the structure to solid foundations. Besides the main spans in connection with this bridge the company is also furnishing and erecting about 2500 feet of steel viaduct, making the total length of the bridge with the viaduct approaches 4470 feet, or nearly seven-eighths of a mile.

The Phoenix Iron Company, of Phoenixville, has also built several

large bridges in recent years. It has recently been awarded a contract by the Indian Government for a bridge over the Jumna River, which will be 1000 feet long—one of the largest bridges in the Orient.

The Westinghouse Industries

One of the notable industries of Pennsylvania is that of the Westinghouse Companies, in the Pittsburgh district. The plants are situated



WESTINGHOUSE WORKS, PITTSBURGH, SHOWING ELECTRIC LOCOMOTIVES

in the valley that extends east from the city along the Pennsylvania Railroad. They include the following companies, mentioned in order of their organization: Westinghouse Air Brake Company, 1869; Westinghouse Machine Company, 1881; The Union Switch and Signal Company, 1882; Westinghouse Electric and Manufacturing Company, 1886; Pittsburgh Meter Company, 1893. The Westinghouse industries located in the city of Pittsburgh are: R. D. Nuttall & Co., 1888, and Nernst Lamp Company, 1901.

The Westinghouse Air Brake Company employs about 4500 men, occupies 30 acres, including over 20 acres of floor space, and has a capacity of over one thousand brake sets per day. It is the largest brake

manufacturing plant in the world. It has equipped 2,580,000 cars and 72,000 locomotives with air brakes, and 300,000 cars and 6000 locomotives with friction-draft gear.

The Westinghouse Machine Company are manufacturers of steam turbines, engines, etc. The plant employs 2150 men and occupies 12 acres of floor space.

The Union Switch and Signal Company, located at Swissvale, eight miles east of Pittsburgh, manufactures signaling and interlocking apparatus. It occupies 40 acres, including 534,000 square feet of floor space, and employs 3000 men. This company was the pioneer in protecting railroad traffic by fixed signals and interlocks.

The Westinghouse Electric and Manufacturing Company, located at East Pittsburgh, twelve miles from Pittsburgh, employs 14,000 people and has 50 acres of floor space under one roof. It manufactures a wide variety of electrical appliances, from a sad iron to the largest electric locomotive. The monthly pay-roll averages over $700,000, and the monthly output averages 750 carloads.

The Pittsburgh Meter Company, located at East Pittsburgh, twelve miles from Pittsburgh, has a daily capacity of 400 water meters, 300 gas meters, and about six proportional gas meters.

The R. D. Nuttall Company, Pittsburgh, manufactures cut and planed gears and pinions, flexible cushion couplings and overhead car equipment. It occupies floor space of 250,000 square feet.

Hardware Manufacture

In its production of hardware, Pennsylvania has borne a high reputation for quality. The industry has centered in Philadelphia, and, as a type illustrative of a general reputation for excellence, the saw works of Henry Disston & Sons at Tacony, near Philadelphia, may be cited. Disston saws are known for their excellence throughout the world, and it is because every step in their making is safeguarded that this reputation is maintained. So that they may know the steel, the Disston works make the steel themselves, and the same attention is bestowed on every process. The Disston plant to-day covers 50 acres of ground; there are 58 buildings and 3500 skilled workmen are employed.

The same character of reputation which this plant bears is held also by Philadelphia manufacturers in a dozen lines of hardware. Files, edge tools—an infinite variety of Philadelphia hardware—has the same high repute as the Disston product.

Ships and Locomotives

AMONG American waters, the Delaware has led in the art of shipbuilding. Within three years after Penn signed his charter he built in Philadelphia a ship called the "Amity," and ever since, despite the decadence of the American merchant marine, shipbuilding has borne an important part among the industries that line the Delaware River. It is a noteworthy fact that in the last great war, that between Japan and Russia, Delaware River shipbuilding was represented on both sides of the conflict. A great part of the navy of the United States of the past and of the present, including some of the most powerful and heaviest of the latest type of battleship construction, were turned out in Delaware River yards.

Most notable of these yards, not only because of its extent, but also because of the part that it has taken in the upbuilding of the United States Navy, is that of the William Cramp & Sons Ship and Engine Building Company in Kensington, Philadelphia. This yard was established by William Cramp in 1830, at the foot of Otis Street, and later occupied a tract at the foot of Palmer Street.

In 1872 the business had outgrown the Palmer Street yard, and about one-third of the water front of the present establishment was purchased. In March of that year the company as it now exists was incorporated under its present name, "The William Cramp & Sons Ship and Engine Building Company."

In 1891 the Cramp Company obtained control of the I. P. Morris Machine Company, and in 1899-1900 large additions were made to the plant, comprising additional building slips and water front, a large new machine shop, and a new power plant.

The first of the men-of-war built at Cramps' was the ironclad "New Ironsides," built in 1862. In the following year the gunboat "Wyalusing" and the monitor "Yazoo" were constructed, and two years later the cruiser "Chattanooga." Following these, there was a lapse of nine years before the building of another warship, when the monitor "Terror" was built. The year 1890 saw the turning out of four warships, and following these were several cruisers and coast defense battleships.

Among first-class battleships, the first to be turned out from the yard was the "Alabama." Warships built since 1900 for the United States Government are:

Name	Type	Keel Laid	Length	Breadth	Draft	Displacement	Contract Speed (Knots)
Alabama	First-class battleship	1900	368	72½	23½	11,570	17.01
Maine	First-class battleship	1902	388	72	23½	12,500	18
Colorado	Armored cruiser	1905	502	69½	24 1/12	13,780	22.24
Pennsylvania	Armored cruiser	1905	502	69½	24 1/12	13,780	22.44
Tennessee	Armored cruiser	1906	502	72½	25	14,500	22.16
Mississippi	First-class battleship	1908	375	77	24 2/3	13,000	17.11
Idaho	First-class battleship	1908	375	77	24 2/3	13,000	17.14
South Carolina	First-class b'ship	1909	450	80	24½	16,000	19.25
Joseph B. Smith	Torpedo-boat destroyer	1909	289	26	8	700	28
Roswell H. Lamson	Torpedo-boat destroyer	1909	289	26	8	700	28
Lewis Warrington	Torpedo-boat destroyer	1909	289	26	8 1/3	742	30
John Mayrant	Torpedo-boat destroyer	1909	289	26	8 1/3	742	30
Thrasher	Submarine torpedo boat	1909	...	..	....	...	..
Cyclops	Collier	1909	520	65	27½	19,200	14
Patterson	Torpedo-boat destroyer	1909	289	26½	8 1/3	742	29.50
Wyoming	First-class battleship	1909	554	93	28½	26,000	20.50

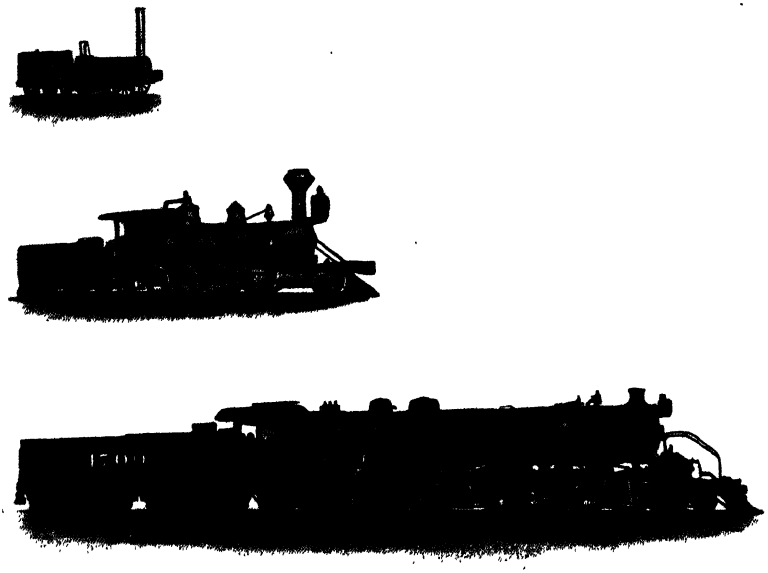
There are now building five torpedo-boat destroyers. These are novel in American construction, in that they have a combination of reciprocating engines with turbine engines. The reciprocating engines are to be used for cruising at low speed, while at high speeds these will be dropped out of service and the turbine engines used. There are to be three screws, two for the turbines and one for the reciprocating engines. These boats are to be 300 feet long and to have a speed of 29½ knots.

The yard also has contracts with the Cuban Government for an 18-knot, 2000-ton cruiser, to be known as the "Cuba," and a 1200-ton, 16-knot, gunboat, to be known as the "Patria." There are also contracts with the Lehigh Coal Mining Company for six 1200-ton sea-going barges, and with W. R. Grace & Co. for a combination freight and passenger steamer of 5000 gross tonnage, to be used on the Pacific coast. This ship is to be 384 feet long and will use oil as fuel.

The Cramp yard has turned out six men-of-war for the Russian navy. In 1879 the corvettes "Asia," "Africa," and "Europe" were built; in 1880, the cruiser "Zabiaka"; in 1901, the protected cruiser "Variag," having a speed of 23¼ knots; and in 1902, the first-class battleship "Retvizan." For the Japanese navy, the protected cruiser "Kasagi"

was built shortly before the Russian-Japanese war, and for the Ottoman navy, the protected cruiser "Medjidia."

The total number of vessels of all descriptions built or building since 1830 is about 375, and the number of marine engines is 290. Over one hundred of the steamers included in the above number range between



EVOLUTION OF THE LOCOMOTIVE, BALDWIN LOCOMOTIVE WORKS

1000 and 12,500 tons register, while the balance of the list is made up of steamboats, tugs, and yachts, with 28 first-class sailing vessels and 100 craft for various special uses. This yard has the distinction of having turned out the only trans-Atlantic liners built in the United States.

New York Shipbuilding Company

The New York Shipbuilding Company, which has its plant in the port of Philadelphia at the lower end of the city of Camden, is one of the most progressive of American yards. The company was organized in 1898, and the work of constructing the buildings started in the summer of 1899. The next year, June 15, 1900, the contract was signed for the first ship, and within six months contracts had been taken for eight ships aggregating 125,000 tons displacement. Even in the face of keen

competition in all lines of ship construction the growth of the yard has been steady, and its reputation has been established for good workmanship and prompt delivery. Its modern equipment, with pneumatic, hydraulic, and electric tools and crane service over all shops and over ships, both on and off the ways, which are under cover, combined with a close inspection by its officials of the work as it progresses, maintains a high standard in quality of output.

In 1903 the company launched the two 615-foot freight and passenger steamers "Mongolia" and "Manchuria," the largest ships launched on the Delaware River, and now plying the Pacific between San Francisco and Hong Kong, China, via Hawaiian Islands, Philippines and Japan.

During that year the keel was laid for the first government contract, the cruiser "Washington," 14,500 tons, launched March 18, 1905. This was followed by the following warships:

Battleship "Kansas," 16,000 tons, launched August 12, 1905; battleship "New Hampshire," 16,000 tons, launched June 30, 1906; battleship "Michigan," 16,000 tons, launched May 26, 1908; battleship "Utah," 21,825 tons, launched December 23, 1909; battleship "Arkansas," 26,000 tons, launched January 14, 1911; torpedo-boat destroyer "Preston," 700 tons, launched July 14, 1909; torpedo-boat destroyer "McCall," 740 tons, launched June 4, 1910; torpedo-boat destroyer "Burrows," 740 tons, launched June 23, 1910; torpedo-boat destroyer "Ammen," 740 tons, launched September 20, 1910; torpedo-boat destroyer "Jarvis," 740 tons, still on the ways; torpedo-boat destroyer "Downes," 1050 tons, still on the ways.

During this interval were constructed numerous freight and passenger steamers, lightships, tugs, dredges, lighthouse tenders, revenue cutters, colliers, car floats, oil tankers, barges, mine planters, and ferryboats, so that in less than ten years from the delivery of the first contract the company is now constructing the 125th vessel.

The yard is now completing for the Argentine Government the battleship "Moreno," 28,000 tons, launched September 23, 1911, the largest battleship afloat, and for the Chinese government a protected cruiser that will be used as a training ship.

Baldwin Locomotive Works

The Baldwin Locomotive Works, Philadelphia, were the first establishment in the United States to be devoted exclusively to the manufacture of locomotives. The first of the many thousands of locomotives

which it has turned out, "Old Ironsides," was the marvel of its day, and in the development of locomotive types, from that day to the present, it has easily been the leader in this country. Not only are its locomotives to-day hauling the heavy freight and fast passenger trains on many leading American roads, but they constitute an important part of the equipment of roads in various foreign countries.

BALDWIN LOCOMOTIVE WORKS, PHILADELPHIA. GEAR-CUTTING SHOP

Matthias W. Baldwin, the founder of the establishment, learned the trade of a jeweler, and entered the service of Fletcher & Gardiner, jewelers and silversmiths, Philadelphia, in 1817. Two years later he opened a small shop, in the same line of business, on his own account. The demand for articles of this character falling off, however, he formed a partnership, in 1825, with David Mason, a machinist, in the manufacture of bookbinders' tools and cylinders for calico printing.

In 1829-30 the use of steam as a motive power on railroads had begun to engage the attention of American engineers. A few locomotives had been imported from England, and one—which, however, was not successful—had been constructed at the West Point Foundry, in New York City. To gratify the public interest in the new motor, Franklin

Peale, then proprietor of the Philadelphia Museum, applied to Mr. Baldwin to construct a miniature locomotive for exhibition in his establishment. With the aid only of the imperfect published descriptions and sketches of the locomotives which had taken part in the Rainhill competition in England, Mr. Baldwin undertook the work, and on the 25th of April, 1831, the miniature locomotive was put in motion.

The success of the model was such that, in the same year, Mr. Baldwin received an order for a locomotive from the Philadelphia, Germantown and Norristown Railroad Company, whose short line of six miles to Germantown was operated by horse power. The Camden and Amboy Railroad Company had shortly before imported a locomotive from England, which was stored in a shed at Bordentown. It had not yet been put together; but Mr. Baldwin, in company with his friend, Mr. Peale, visited the spot, inspected the detached parts, and made a few memoranda of some of its principal dimensions. Guided by these figures and his experience with the Peale model, Mr. Baldwin commenced the task. The difficulties to be overcome in filling the order can hardly be appreciated at this day. There were few mechanics competent to do any part of the work on a locomotive. Suitable tools were with difficulty obtainable. Cylinders were bored by a chisel fixed in a block of wood and turned by hand. Blacksmiths able to weld a bar of iron exceeding one and one-quarter inches in thickness were few, or not to be had. It was necessary for Mr. Baldwin to do much of the work with his own hands, to educate the workmen who assisted him, and to improvise tools for the various processes.

The work was prosecuted, nevertheless, under all these difficulties, and the locomotive was fully completed, christened "Old Ironsides," and tried on the road November 23, 1832.

The "Ironsides" was a four-wheeled engine, modeled essentially on the English practice of that day, as shown in the "Planet" class, and weighed, in running order, something over five tons. This pioneer locomotive attained a speed of thirty miles an hour, with its usual train attached.

The total number of locomotives built each year since 1906 is as follows: 1907, 2655; 1908, 617; 1909, 1024; 1910, 1675; 1911, 1606. Locomotive No. 31000 was built in 1907, No. 32000 in 1907, No. 33000 in 1908; No. 34000 in 1909, No. 35000 in 1910, No. 36000 in 1911, No. 37000 in 1911, No. 37500 in January, 1912.

Since 1907 practically all the extension of the works has been

carried on at Eddystone, between Philadelphia and Chester. This plant consists of twenty-six buildings, which are located on a tract of 224 acres. The principal buildings are one story in height, and are of fire-proof construction, with steel frames, hollow terra-cotta tile walls, and cement tile roofs. The plant now includes an erecting shop, which is specially arranged and equipped for erecting locomotives of the largest types.

MALLET ARTICULATED LOCOMOTIVE, BUILT AT BALDWIN LOCOMOTIVE WORKS

The first Mallet articulated locomotives of the 2-8-8-2 type were built for the Southern Pacific Company in April, 1909. These locomotives were designed for freight service on the Sacramento Division of the Central Pacific Railroad, where the maximum grade is 2.2 per cent. Subsequent locomotives of this type have been built to run with the cab end leading, in order to give the enginemen an unobstructed view of the track. In 1911, twelve locomotives of the 2-6-6-2 type were built and placed in passenger service on this division. These engines are in many respects similar to the freight locomotives, and are run with the cab end leading. All these Mallet locomotives use oil as fuel.

In November, 1909, a Mallet unit was built for the Great Northern Railway and was applied to the front end of an existing Consolidation engine, thus converting the latter to a Mallet articulated locomotive with 2-6-8-0-wheel arrangement. A limited number of locomotives on other roads have been rebuilt in this way. Among them are ten locomotives on the Atchison, Topeka and Santa Fe Railway, which have been changed from the 2-10-2 type to the 2-10-10-2 type. These are the largest locomotives at present in service, weighing each 616,000 pounds.

In 1910 a locomotive with an articulated boiler and 2-6-6-2-wheel arrangement was built for the Atchison, Topeka and Santa Fe Railway. The boiler joint is composed of a series of steel rings, which are fastened together to form a bellows-shaped structure, thus providing the necessary flexibility. The front boiler section contains a feed-water heater, and is rigidly secured to the frames. This type of articulated locomotive is the invention of Samuel M. Vauclain. Four additional locomotives of this type were built in 1911.

A Mikado-type locomotive, specially equipped for burning lignite, was built for the Oregon Railroad and Navigation Company in 1910. This locomotive proved remarkably successful and was followed in 1911 by 101 similar engines, which were widely distributed over the associated lines. By using low-grade fuel from supplies near at hand, these locomotives effect substantial economies when compared with locomotives burning good coal which must be hauled from distant mines.

During the year 1911, forty Pacific-type and 160 Mikado-type locomotives were completed for the Baltimore and Ohio Railroad. Thirty of the Pacific and twenty of the Mikado-type locomotives were equipped with superheaters. These engines are remarkable because of the large number of parts which are interchangeable in the two types.

A notable order for export, filled in 1911, consisted of twenty locomotives of the 10-wheeled type for the Victorian Government Railways.

An important order filled in December, 1911, and January, 1912, called for fifty locomotives of the Pacific type for the New York Central and Hudson River Railroad. Thirty of these engines are for freight service and twenty for passenger service. These locomotives were built with unusual dispatch, in accordance with designs and specifications furnished by the railroad company. The Atchison, Topeka and Santa Fe Railway also received twenty-eight Pacific-type locomotives with balanced compound cylinders. In accordance with recent practice on this road, these engines have sectional fireboxes of the Jacobs-Shupert type.

The partnership of Burnham, Williams & Co., entered into in 1891, and last renewed in 1907, was dissolved July 1, 1909, and a stock company under the name of Baldwin Locomotive Works was incorporated, with John H. Converse as president. Mr. Converse died May 3, 1910.

On July 1, 1911, the entire property owned by Baldwin Locomotive Works was sold to a new corporation, The Baldwin Locomotive Works. This is a public joint stock company.

The Textile Industries

FOLLOWING iron and steel manufacture in the order of importance comes the vast textile industry of the State, which is centered in the city of Philadelphia, but which represents a very large part of the manufactured output of many of the other cities of the State. When it is realized that the value of Pennsylvania production of silk alone is, approximately, $60,000,000 annually, and that woolens, yarns, and allied lines represent a far greater amount, a conception will be gained of the extent of this branch in the State. In kindred lines there has been a notable advance in recent years. Twenty years ago, for instance, virtually no tapestries were made in America. So far as the United States are concerned, this industry was created by Pennsylvania enterprise, and up to five years ago more than 90 per cent. of all American-made tapestries were turned out from the looms of this State. In the same way the lace curtain industry has sprung up within two decades. Whereas, prior to 1895 virtually all of the lace curtains in American homes came from the factories of the old-world centers of Nottingham, Calais, Plauen, and St. Gall, to-day eastern Pennsylvania has the largest lace curtain establishments in the world. The industry, started in Philadelphia, is spreading to other cities of the State.

The position of Pennsylvania in the textile world to-day has been a matter of steady growth, beginning soon after the founding of the colony. As early as 1700 hosiery was made in Germantown by the Mennonites, who brought rough frames from Germany and set them up in their homes. Later, English knitters came from Leicester and Nottingham, bringing with them improved frames, which speedily gave them advantage over the Mennonite makers. The first knitting mill in the country was established in Germantown, in 1825, by Thomas R. Fisher. Prior to this time all of the hosiery made in this country was turned out in the homes of the knitters. To-day there are 188 establishments in the State engaged in the making of hosiery alone, and the value of the output is approximately $30,000,000. Philadelphia, with an output in excess of $15,000,000, easily exceeds any other city in the country in the extent of this industry.

Carpets were first made in this country in 1775 by William Calverly,

in Philadelphia. He was followed by William P. Sprague, who made Turkish and Axminster carpets in Philadelphia as early as 1791. One of Mr. Sprague's productions was a handmade tufted carpet adorned with patriotic emblems for the floor of the United States Senate. This resulted in Alexander Hamilton having a tariff of from 5 to 7½ per cent. laid on all such imported stuffs, so as to encourage their home manufacture.

A GLIMPSE OF PHILADELPHIA'S CARPET INDUSTRY

Dorsey followed with a carpet, half oilcloth and half carpet, seven feet wide; he was succeeded by Macauley in 1808, who developed the manufacture of Kidderminster, or Scotch carpets, known in the United States as ingrain carpets. This was the beginning of the enormous ingrain carpet industry of Philadelphia.

It is but a few years since two or three wards in the city of Philadelphia made more carpets than all the rest of the country combined. That was, however, in the day when there was a big market for ingrain carpets in the United States. Quarter of a century ago many of the homes along the Atlantic seaboard had ingrains covering their floors. Then, with the increase in prosperity, the East began to demand finer floor coverings and to reject ingrains. The market moved westward,

and still the ingrain mills were kept running at capacity, but, with the marvelous new prosperity of the Middle West and West, these sections also began to demand Brussels and velvets and wiltons, and the market for ingrains rapidly contracted.

The manner in which the carpet mills met this new trade situation is a chapter that demonstrates the resourcefulness of Pennsylvania manu-

CARPET INDUSTRY, PHILADELPHIA

facture. The ingrain capacity has been gradually contracted in compliance with the market, and the mills, as necessity demanded, went to other branches. Those mills that still make ingrains—and the production is still large—have improved the character of their goods to command a market. Many devote part of their capacity to the making of rugs. In some cases new specialties were invented which took the place of the manufacture of ingrain. To-day there are no such number of carpet looms in operation as formerly, in the same restricted territory, yet the State still holds its lead in this line of activity.

Pennsylvania, though settled by Penn sixty years after the New England States, early held a prominent position in the manufacture of cotton goods. The first spinning-jenny seen in this country was exhibited at

Philadelphia in 1775. The first joint-stock company in the United States and probably the first company to make cotton goods was organized in Philadelphia in 1775, and known as "The United States Company of Philadelphia for Promoting American Manufactures." Slater, the pioneer of the cotton manufacturing industry in New England, was induced to come to this country through a notice in a newspaper that the Pennsylvania Legislature in 1788 had granted a premium of £10 to John Hague for introducing a machine for carding cotton. The first calico printing done in the United States was by John Hewson in 1789 at Philadelphia. This is one of the branches in which, to-day, Pennsylvania excels in its manufacture of specialties. The staple lines of cotton production have gone to other districts, and in recent years there has been a marvelous increase in the number of spindles in the South, by the side of the cotton fields. Pennsylvania manufacture of cotton is now represented, largely, by lace curtains and tapestries, although, of course, in this last-named branch of manufacture, there are used considerably more than a hundred different grades of yarn in cotton, silk, linen, and jute. The output of prints is still large, one of the leading establishments in this line being the Eddystone Print Works, near Chester.

The first silk manufacture in the United States was in Philadelphia in 1815, when W. H. Horstmann made silk trimmings. This firm still continues to manufacture trimmings and other forms of silk manufacture. They were the first to introduce the Jacquard loom into this country. State figures for 1910 give the number of silk establishments in Pennsylvania as 185 and the total production, approximately, $60,000,000 annually. The city of Scranton and the district within a radius of sixteen miles handles one-third of all the raw silk that comes into the United States, and there are located here some of the world's largest plants in this line of industry. Several of the other cities of the State have important silk mills.

Textiles are the foundation of the Philadelphia industrial structure. Important as are the shipyards of the city, its locomotive shops, and its various mills which turn out the greater iron and steel products, yet its looms and the various processes in the manufacture of textile fabrics give employment to by far the greater number of workmen and operatives. Virtually all classes and grades of worsted and woolen fabrics are made in the multitude of mills. Carpets constitute the great volume of manufacture, yet the finest in women's wear and in men's suitings, and the greatest range of specialties, are covered by the Philadelphia mills in this

field. There is a popular belief that New England leads the country in textile manufacture. Yet the combined output of the factories of the three largest textile manufacturing cities of New England does not equal that of Philadelphia's mills.

This misconception is doubtless due in great measure to the fact that the textile cities of the Eastern States are noted almost exclusively for

LINOLEUM INDUSTRY—CRUDE FABRIC AT NEAR END OF MACHINE, FINISHED LINOLEUM AT FAR END

this one line of manufacture, while Philadelphia's products are so varied, and its reputation so wide for other lines, that its importance as a city of textile mills is not generally realized. More than one-third of the wage-earners of Philadelphia are engaged in its textile industries, and almost 30 per cent. of the value of its products is represented by the output of these mills.

In 1904, according to the census, there were 7087 manufacturing establishments in Philadelphia, employing 228,899 persons, with an output valued at $591,000,000. Of these factories, 1331, with 80,310 employees and an output valued at $170,000,000, were engaged in the textile industries alone Figures given in the report of the factory inspector for the

year 1909 show that there were 102,459 persons employed in the textile industries of Philadelphia in that year, as compared with 80,310 employed in 1904, according to the United States Census. This is an increase of 27 per cent., and assuming that the increase in the value of the products would be at the same ratio, although probably it would be greater, the value of the products of the textile industries in Philadelphia in 1909 would be about $215,000,000.

The values of the output of the more strictly speaking textile industries of Philadelphia are given in the following table, the leading lines being included:

Worsted goods	$26,900,000
Carpets and rugs	25,200,000
Cotton goods	17,400,000
Hosiery and knit goods	15,700,000
Woolen goods	12,200,000
Silk goods	5,700,000
Dyeing and finishing textiles	4,300,000
Cordage and twine	4,000,000
Oil cloth	4,000,000
Upholstering materials	2,200,000
Millinery and lace goods	2,100,000

This table does not take account of the very large production of yarns. It is natural that Philadelphia should have its high place in this branch, for it is a decided advantage to the textile manufacturer to be close to his yarn supply. The proximity of many important mills would naturally tend to build up the yarn industry near at hand. Of the scores of grades of yarns used in the mills there is not one but can be supplied by the home market.

Diversity of Manufactures

THE initiative manifested by Pennsylvania manufacturers in recent years, which has brought about improvement in so many lines of merchandise, was paralleled by the creative ability shown by the pioneers in the various lines of industry. Pennsylvania has been a creator of industries which, besides developing within her borders, have spread far beyond the lines of the State.

There is scarcely a branch of manufacture in the history of which Pennsylvania has not played an important part, and to-day, as in the past, the industries of the State are as virile and progressive as those of any other State in the Union.

As an illustration of this creative ability may be cited the birth and growth, in Philadelphia, of the glazed-kid industry. Fortunes were sunk before the secret of the chrome tannage of goat skins was solved. In the early history of the development of this industry the name of Robert H. Foerderer has a prominent place. Within a few years after it had been demonstrated that the process would be a commercial success the industry was firmly rooted in Philadelphia. It has since spread to nearby territory, but Philadelphia has continued to be easily the glazed-kid center of the country, manufacturing a very high percentage of the total production. The extent of the industry to-day is indicated by the fact that in the calendar year 1911 upward of 16,000,000 goat skins were imported through the port of Philadelphia.

This development maintained for Pennsylvania a prestige in the tanning industry, which it has held almost from the beginning of its history. Partly because it was in the early years one of the important cattle-raising colonies, and partly because it contained the trees that yielded tannic acid, attention was given to the industry of tanning hides at a very early period. In the fore part of the nineteenth century Pennsylvania not only supplied leather for its own wants and shipped into other States, but also sent considerable amounts to foreign countries.

In the manufacture of boots and shoes the State has never approached New England in volume of production. Its output, especially in women's shoes is, however, of notably high character.

The creative courage shown in the lace curtain and tapestry industries has already been touched upon. Production in these two lines began in Philadelphia, and is still centered there. For years the city produced more than 90 per cent. of the country's entire output in these two lines.

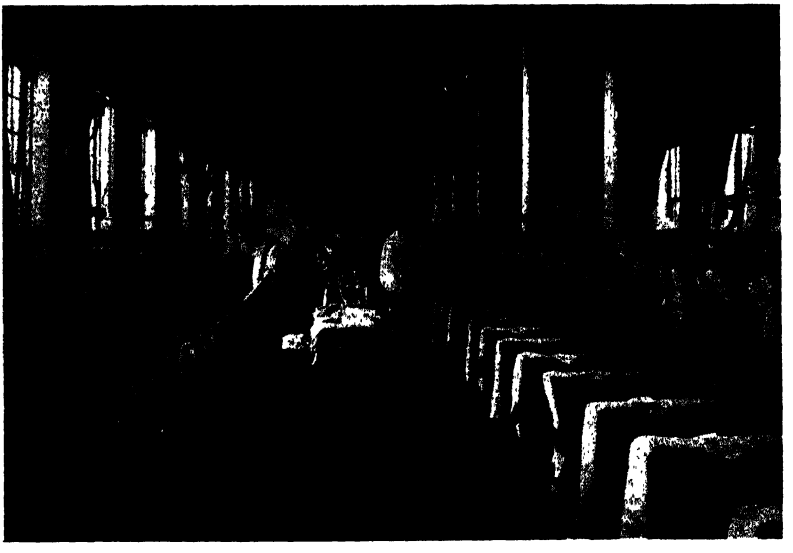
In the oil, drug, and chemical trade Philadelphia has always been an important factor. The first successful attempt to make white lead in this country was by Samuel Wetherill & Son, in Philadelphia, in 1804. This firm is still in existence, and carries on the manufacture of white lead and other chemicals in Philadelphia. The manufacture of the oxides of lead began about the same time. Christopher Shrack began business as manufacturer of paints in Philadelphia in 1816, and also manufactured copal varnish on a small scale.

As the country has increased in population and wealth, there has been an advance in the decorative arts that has taxed the resourcefulness of the manufacturer of paints. Philadelphia makers of colors were from the beginning quick to grasp the possibilities of this development, with the result that the city has maintained its place in the industry. There are, however, important paint-making establishments in a dozen other cities of the Commonwealth.

Doubtless the concentration of the chemical industry in the eastern part of the State has had an important influence in the upbuilding of the paint industry.

Illustrative of the high character of production which distinguishes Pennsylvania output in so many lines is the hat-making industry of the John B. Stetson Company. Stetson hats are sold all over the world, and it is a noteworthy fact that the largest single customer of the house is in South America. John B. Stetson, who founded the business in 1865, conceived the idea that a successful hat business could be built up by making the best hat that could be made with given material; and the industry has since been conducted on that basis. At present there are employed, in round numbers, 5400 people. This business is unique, in that it is the only hat manufacturing plant in the world where a complete hat is made. The fur-bearing skins are imported in their original condition. Even the bands and bindings are woven in the Stetson factory. At present this branch is producing upward of 6,000,000 yards annually, the making of which requires 40,000 pounds of raw silk. The finished sheep skins, from which the leather sweat bands are made, are imported from France, Belgium, and Russia, and cut into sweats at the factory. For this purpose 330,000 sheep and calf skins are used in a single year.

FINISHING HATS IN THE STETSON FACTORY



KNITTING INDUSTRY, PHILADELPHIA

The paper boxes in which the hats are packed are also manufactured in the plant, and for this purpose 820 tons of box board were required in 1911.

During the year of 1911 the Stetson factory manufactured 3,336,000 hats, an average daily output of 11,000 hats. The buildings occupied cover about five acres of ground, providing 24 acres of floor space.

It is noteworthy that the other large hat manufacturing plants which have sprung up, especially in the eastern part of the State, have shown the same adherence to a high standard of quality. There is virtually no low-grade production in the State in this line, a condition which again emphasizes the fact that the high labor market of a manufacturing center such as Philadelphia tends steadily, not only toward specialization in manufacture, but also to high quality in production.

One of the many industries that have made notable advance in the State in recent years is the manufacture of cork. Among the leaders in the development of this industry is the Armstrong Cork Company, of Pittsburgh. From this plant comes a wide array of articles made from "corkwood," or the cork of commerce, which is the outer bark of the cork oak. Spain and Portugal divide honors among the nations of the world so far as yield of raw material is concerned, with perhaps the advantage leaning slightly to the latter. In these two countries a large part of the production goes to supply domestic factories, where more and more machinery is being introduced every year. With these exceptions, however, the major part of the yield is exported to the United States, England, France, Germany, Austria, Russia, Denmark, or Sweden, to be turned into finished form. The Armstrong Company is one of those that have modernized the industry by the introduction of new machinery and methods. Besides the ordinary bottle "stoppers," the plant makes, in large quantities, insoles, washers, life preservers, pen holders, cork paper for cigarette tips, and a host of other articles.

In the manufacture of oil cloth and linoleums, Philadelphia was the pioneer city of the country. The output of Thomas Potter Sons & Co., the George W. Blabon Company, and nearby concerns still constitute a large percentage of the total production in the United States.

Naturally the refining of petroleum has been an important industry along the Delaware. All of the petroleum formerly came to the refineries by pipe line from the Pennsylvania fields, but in recent years the refining of oil from other fields, notably Texas, brought to the refineries by water, has been steadily increasing in volume.

SILICA BRICK PLANT, HARBISON-WALKER REFINING CO., PITTSBURGH

GRINDING CUT GLASS

A notable development that may be regarded as being the result of Pennsylvania enterprise is that of the Welsbach Company. The control of this company is held by the United Gas Improvement Company, and the period of greatest development began when this company assumed control.

The property covers 21 acres, and the buildings number 96, having a floor space of 361,000 square feet. The number of employees is 1504. A summary for the past 10 years shows the output of incandescent gas burners and mantles as advancing yearly. For 1911 the burners were over 3,500,000, and the mantles, 31,000,000. The company also made a large quantity of gas fixtures and other illuminating devices.

Among the oldest and yet most progressive industrial branches in the State is the manufacture of glass. Pennsylvania led in this industry before the Revolution, and it leads to-day. Pittsburgh alone has 27 glass plants and 24 glass-cutting, staining, and ornamenting plants, the combined capital being in excess of $21,000,000. In the development of process in glass manufacture these plants are to-day taking a leading part.

Pittsburgh may be regarded as the cradle of the glass industry in America, for it has been the scene of the working out of most of the improvements in process and in labor-saving machinery which have revolutionized the industry in the past two decades. The first machine-made bottles to be made in this country were turned out in Pittsburgh, on Philip Arbogast's machine, in 1882, the rights on this patent expiring in 1899. The bottle industry is still using substantially the Arbogast process—what is known as the "interchangeable type" of mold—with the vacuum process added, which makes the machine practically automatic. The first window glass machine also was operated in Pittsburgh in 1894, being promoted by the interests that afterward merged the principal factories in the country into the American Window Glass Company.

In pressed and table glassware, the United States Glass Company's plants saw the first development of the improvements of recent years which have made possible immense advances in the pressed ware industry. Notable among these was the introduction of the blower, to cool molds by wind, making possible lighter molds which can be handled more rapidly and are capable of producing a finer grade of work. In the field of lighting glass, improvements in molds and methods of manipulation and the first plants for the production of glass electrical supplies were established in the Pittsburgh district, and it also led in the development of the porcelain electric supply industry.

In recent years, however, the achievements of the Pittsburgh district industry in plate glass are perhaps the best known in the glass trade. For years it was believed that American glass makers could not produce French plate. The late Capt. John Ford, of Ford City, Pa., a town north of Pittsburgh on the Allegheny River, who had been a captain on a river steamer, left the river and went into glass in the late eighties. He revo

HANDLING MOLTEN GLASS IN ORDER TO BLOW A WINDOW-GLASS CYLINDER

lutionized the plate glass industry in this country, in the matter of mechanical facilities. He substituted power for hand labor, perfected the furnace system of melting, and improved the system of annealing glass in lehrs instead of ovens. His plants furnished the basis for the consolidation now known as the Pittsburgh Plate Glass Company.

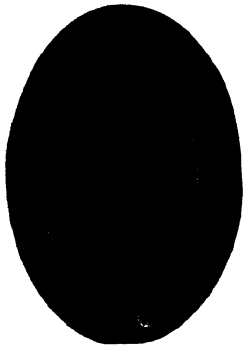
Improvements are now being perfected in Pittsburgh in the wire and ribbed glass industry, that promise to result in important advances in this newest branch of glass manufacture. Although there have been frequent removals of plants from Pittsburgh territory to points further west—notably the historic migration of a section of the chimney and lamp glass industry from Pittsburgh proper to the then newly discovered "gas belt" of Indiana in the later nineties—the backbone of the industry

seems likely to remain fixed in the Pittsburgh district for many years to come.

The Government's 1910 census for the Metropolitan District of Pittsburgh gives the total production of glass of all kinds for the census district in 1909, as $8,765,000. The district included under this name comprises not quite all of Allegheny County. The output of the territory contiguous to Pittsburgh and controlled by Pittsburgh companies is, however, several times this total, the industry having largely moved to surrounding towns, 20 to 50 miles distant from the city proper. The city is the headquarters of the American Window Glass Company, controlling the window glass trade; the Pittsburgh Plate Glass Company, which has almost à monopoly of the plate glass business in this country; the Macbeth and other large producers of chimney and lamp glass; several concerns producing glass electric goods, and the United States Glass Company, the largest producer of pressed glass and tableware lines in the country.

The 21 plants in Pittsburgh territory devoted to bottle glassware—which is a branch of the trade that has not been very greatly affected by the merger movement in America, and is still largely in the hands of individual companies—produced in 1910, according to trade reports based on tank capacity, $10,265,000 worth of bottles. The plate glass output of the district was estimated at $8,000,000; the tableware output at $6,000,000. The city is an important center for the manufacture of cut, etched, stained, and decorative art glass, as well. The district also is becoming an important producer of wire glass and ribbed glass, a comparatively new product, which is increasing in favor as a fire retardent.

THE CITIES OF THE COMMONWEALTH

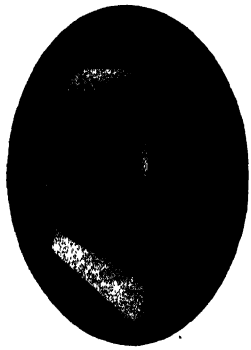


FRANK D. LA LANNE
Chairman Reception Committee

E. W. DRINKER
Vice-Chairman Publications Committee

W. O. HEMPSTEAD
Vice-Chairman Transportation Committee

H. F. STETSER
Vice-Chairman Committee on Local Excursions



HORACE A. DOAN
Vice-Chairman Reception Committee

WM. H. HOLLAR
Vice-Chairman Committee on Place of Meeting

Two Centers of Industry

SITUATED at the east and west extremities of the State are two industrial centers which, in their lines of production, are unquestionably the leaders among American cities. Back in 1842, Charles Dickens wrote: "Pittsburgh is like Birmingham in England; at least, its townspeople say so." Wonderful as was Dickens' genius in the depiction of human nature, this, with its implied doubt as to the future of Pittsburgh, would indicate that he was no prophet of industrial advance. For to-day it would be a high compliment to Birmingham to speak of it as the Pittsburgh of England.

The Pittsburgh district to-day develops far greater tonnage than any like area in the world. It is one of the great pulsating industrial centers—in some respects the greatest.

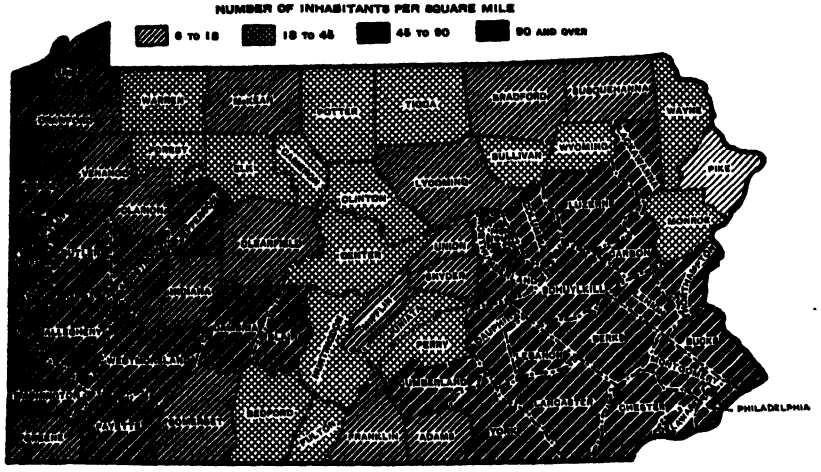
Even more notable as an industrial center, considering the number of establishments, value of production, and high quality of output, is Philadelphia, from which sprang the industry of the State. In variety of production as well as in its high average of quality, Philadelphia, to-day, leads American cities. With a high labor market that has slowly tended to drive cheaper quality of production to centers where cheaper labor could be procured, Philadelphia manufacture has tended steadily toward the highest grades of specialties in all lines of merchandise. It was only so that the high labor market could be supported; and the result is, to-day, a reputation for quality in its many lines of merchandise.

That Philadelphia's advance as an industrial city is unchecked is shown by the latest census figures. The advance for 1909 as compared with 1904 is as follows: 33 per cent. in the capital invested; 47 per cent. in the number of salaried officials and clerks; 29 per cent. in the cost of materials used; 27 per cent. in the value of products; 23 per cent. in the value added by manufacture; 25 per cent. in the salaries and wages; 24 per cent. in the miscellaneous expenses; 10 per cent. in the average number of wage earners, and 18 per cent. in the number of establishments.

There were 8381 manufacturing establishments in 1909 and 7087 in 1904, an increase of 1294, or 18 per cent.

The capital invested as reported in 1909 was $692,115,000 and $520,179,000 in 1904, an increase of $171,936,000, or 33 per cent. The average capital per establishment was approximately $83,000 in 1909 and $73,000 in 1904.

The cost of materials used was $430,799,000 in 1909, as against $333,352,000 in 1904, an increase of $97,447,000, or 29 per cent. The



DENSITY OF POPULATION, PENNSYLVANIA

average cost of materials per establishment was approximately $51,000 in 1909 and $47,000 in 1904.

The value of products was $749,183,000 in 1909 and $591,388,000 in 1904, an increase of $157,795,000, or 27 per cent. The average per establishment was approximately $89,000 in 1909 and $83,000 in 1904.

The value added by manufacture was $318,384,000 in 1909 and $258,036,000 in 1904, an increase of $60,348,000, or 23 per cent. This item formed 42 per cent. of the total value of products in 1909 and 44 per cent. in 1904.

The miscellaneous expenses amounted to $68,897,000 in 1909 and $55,449,000 in 1904, an increase of $13,448,000, or 24 per cent. The average per establishment was approximately $8,000 in 1909 and in 1904.

The salaries and wages amounted to $166,129,000 in 1909 and $133,037,000 in 1904, an increase of $33,092,000, or 25 per cent.

The number of salaried officials and clerks was 33,473 in 1909 and 22,839 in 1904, an increase of 10,634, or 47 per cent.

The average number of wage earners employed during the year was 252,221 in 1909 and 228,899 in 1904, an increase of 23,322, or 10 per cent.

The comparative summary for the city, 1904 to 1909, follows:

	Census 1909	Census 1904	Per Cent. Increase 1904-1909
Number of establishments	8,381	7,087	18
Capital invested	$692,115,000	$520,179,000	33
Cost of materials used	$430,799,000	$333,352,000	29
Salaries and wages	$166,129,000	$133,037,000	25
Miscellaneous expenses	$68,897,000	$55,449,000	24
Value of products	$749,183,000	$591,388,000	27
Value added by manufacture (products less cost of materials)	$318,384,000	$258,036,000	23
Employees:			
Number of salaried officials and clerks	33,473	22,839	47
Average number of wage-earners employed during the year	252,221	228,899	10

Pittsburgh also showed a notable advance as follows: Six per cent. in the number of establishments; 9 per cent. in the capital invested; 15 per cent. in the value of products; 19 per cent. in the cost of materials used; 10 per cent. in the value added by manufacture; 28 per cent. in the number of salaried officials and clerks; and 6 per cent. in the salaries and wages.

There was a decrease of 6 per cent. in the average number of wage earners. There were 1659 manufacturing establishments in 1909 and 1562 in 1904, an increase of 97, or 6 per cent.

The capital invested as reported in 1909 was $283,139,000 and $260,765,000 in 1904, an increase of $22,374,000, or 9 per cent. The average capital per establishment was approximately $171,000 in 1909 and $167,000 in 1904.

The value of products was $243,454,000 in 1909 and $211,259,000 in 1904, an increase of $32,195,000, or 15 per cent. The average per establishment was approximately $147,000 in 1909 and $135,000 in 1904.

The cost of materials used was $148,527,000 in 1909, as against $124,581,000 in 1904, an increase of $23,946,000, or 19 per cent.

The value added by manufacture was $94,927,000 in 1909 and $86,678,000 in 1904, an increase of $8,249,000, or 10 per cent. This item formed 39 per cent. of the total value of products in 1909 and 41 per cent. in 1904.

The miscellaneous expenses amounted to $19,552,000 in 1909 and $19,087,000 in 1904, an increase of $465,000, or 2 per cent. The average per establishment was approximately $12,000 both in 1909 and 1904.

The salaries and wages amounted to $52,656,000 in 1909 and $49,558,000 in 1904, an increase of $3,098,000, or 6 per cent.

The number of salaried officials and clerks was 10,598 in 1909 and 8273 in 1904, an increase of 2325, or 28 per cent.

The average number of wage earners employed during the year was 67,474 in 1909 and 71,618 in 1904, a decrease of 4144, or 6 per cent.

The comparative summary for the city, 1904 and 1909, follows:

	Census		Per Cent. Increase
	1909	1904	1904-1909
Number of establishments	1,659	1,562	6
Capital	$283,139,000	$260,765,000	9
Cost of materials used	$148,527,000	$124,581,000	19
Salaries and wages	$52,656,000	$49,558,000	6
Miscellaneous expenses	$19,552,000	$19,087,000	2
Value of products	$243,454,000	$211,259,000	15
Value added by manufacture (products less cost of materials)	$94,927,000	$86,678,000	10
Employees:			
Number of salaried officials and clerks	10,598	8,273	28
Average number of wage-earners employed during the year	67,474	71,618	6

Philadelphia leads the country particularly in the extent and character of its textile industries. Pittsburgh's industrial importance is due primarily to the coal lands by which it is surrounded, which to-day attract the ore of the Lake Superior ranges to its furnaces, and which has thus built up its vast iron and steel plants.

It is a well-known fact that the Pittsburgh district develops a far greater tonnage than any district of equal size in the world. Figures recently prepared by the Pittsburgh Industrial Development Commission give the following comparative statistics:

Year 1909	Tons
Port of Liverpool	14,341,088
Port of Marseilles	15,172,000
Port of London	19,665,134
Port of. Hamburg	22,955,533
Port of New York	25,584,721
Suez Canal	23,633,283
Tonnage of Great Lakes (more than half of which is contributed by Pittsburgh)	159,727,372
Pittsburgh's tonnage	167,733,678

The tonnage of New York, London, Hamburg, and Marseilles, the greatest maritime ports of the world's four great maritime nations, com-

bined, was 83,376,388 tons. Pittsburgh's tonnage, 167,733,268 tons, is double this total.

Figures prepared for "Pittsburgh Against the World" in pig iron production for 1909, show as follows:

	Tons
Pittsburgh district	7,134,502
France and Russia combined	6,448,670
State of Ohio entire	5,551,545
Austria-Hungary, Belgium, Canada, Sweden, and Spain combined	5,186,351
States of Illinois, Indiana, and Michigan combined (including Chicago and Gary)	3,431,445
State of Alabama	1,763,617

Pittsburgh's production of pig iron in 1909 was 60 per cent. of the total for Germany, and 70 per cent. of the total for Great Britain. Pittsburgh district produced in 1909 as much pig iron as the combined countries of France, Russia, and Canada. Pittsburgh district in 1909 produced 11 per cent. of the world's output of pig iron.

In 1910 Allegheny County made over 19.5 per cent. of the country's total production of pig iron. It made over 54.1 per cent. of the total production of steel ingots and castings in Pennsylvania and over 27.3 per cent. of the country's total production. It made over 55.3 per cent. of the production of structural shapes in Pennsylvania and over 41.9 per cent. of the country's total production. It made over 47.7 per cent. of the production of plates and sheets in Pennsylvania and over 27 per cent. of the country's total production. It made 52.6 per cent. of all kinds of finished rolled iron and steel in Pennsylvania and over 26.2 per cent. of the country's total production.

In 1910 the Pittsburgh district produced one-third of the glass output of the country and one-tenth of all the heavy power machinery and heavy engines. These figures, of course, include manufacture and tonnage outside of the city proper; but they are in what is held to be the zone of Pittsburgh activity. By the Pittsburgh district is meant the territory within a radius of 40 miles, having Pittsburgh as its center. The district claims the largest plants in the following lines: Pipe and tube, structural steel, wire, brakes, aluminum and finishing, pickling and preserving, and electrical manufacturing.

Pittsburgh is the heaviest producer of structural and bridge material in this country. The three largest interests in this field have their headquarters and their principal plants in this district—the American Bridge Company, which is the United States Steel Corporation's fabricating

subsidiary, the McClintic-Marshall Construction Company, and the Riter-Conley Manufacturing Company.

The McClintic-Marshall Company has been the contractor for the fabricating and erection of the lock gates at the Panama Canal, the contract involving 60,000 to 80,000 tons of steel, on which the contract price was $5,000,000. A part of these lock leaves, as they are technically termed, had to be erected complete at the Rankin shops of the company and passed on by the government inspectors before they were accepted for shipment to Panama. The contract necessitated the building of the company's own erecting shops at Colon.

The same business acumen that was so great a factor in the rapid advance of Pittsburgh is to-day being exercised to protect its industrial position. Early leaders in the city's industry grasped firmly the principle that production at the base of raw supply saves transportation costs and means economy in manufacture. It was the courageous backing of this conviction that made Pittsburgh the industrial marvel of the age.

But Pittsburgh business men of to-day realize that new fields of supply which have been opened have created conditions that did not exist when the city's era of prosperity began. Firmly as they believe in the future of Pittsburgh along its present lines of production, they are taking steps to fortify its position still further. The Pittsburgh Industrial Commission was organized, largely, to aid in the diversification of the city's manufacture by attracting new lines of trade. Leaders in the manufacturing life of Pittsburgh have seen the importance of establishing manufactures that will give employment to women, so that the daughters of workmen in the iron and steel mills may find employment at hand.

The same broad-minded policy has led to the creation of a commission to study the means of regulating the floods which, from time to time, endanger the interests along the three rivers. That this danger is important is shown by the fact that from March 15, 1907, to March 20, 1908, Pittsburgh suffered a direct loss, as a result of three floods, of $6,500,000. The National Waterways Commission estimates the flood losses in the Ohio Valley in 1907 at more than $100,000,000. To prevent this, a system of artificial reservoirs has been proposed, and 43 reservoir sites, on the rivers above Pittsburgh, have been surveyed. It is calculated that, besides controlling floods, these reservoirs will be of important value in increasing the low-water flow of the Ohio as well as in the development of power.

Pennsylvania Cities

SCRANTON, in Lackawanna County, in point of population ranks third among Pennsylvania cities, with 129,867 people. The population within a 10-mile radius is 314,538. In 1890 the population of the city was 75,215. Scranton has shown a consistent advance of a little more than 25,000 in each recent decade. The city has an elevation above tide level ranging from 800 to 1800 feet. While the general manufacturing interests of the city are important, Scranton is distinctively an anthracite coal center, one-quarter of all the anthracite in the world being mined within a radius of 15 miles from the city. There are 20,000,000 tons taken out of the ground annually in this territory, and its value at the mines averages $46,000,000. Within the city limits the industry gives employment to 15,000 hands.

Aside from the mining of coal, an almost equal number of workers find employment in other occupations. There are numerous plants engaged in the production of a varied line of heavy metalware, such as stoves and furnaces, grates and blowers, scales and screens, mining machinery, axles and springs, bolts and nuts, pumps, brass goods, aluminum wares, etc.

The textile lines are also largely represented in this city. One-third of all of the raw silk imported into the United States is handled within sixteen miles of Scranton. Some of the largest mills in the world are located here, and as a city it ranks second in this industry in the nation. There are also extensive woolen and cotton mills, and one of the largest lace curtain mills in the United States. The largest composition button factory in the world is located here, where in addition to turning out 3,000,000 buttons per day, an infinite variety of composition specialties are made. These include such articles as telephone receivers and transmitters, magneto boxes, switches, and all kinds of electrical devices made of insulated composition material.

The number of industrial plants is 293, and the annual value of production is $26,385,000. There are 19 banks and three trust companies in the city, with capital and surplus of $11,279,436, and total deposits of $34,079,662, and clearing in 1910 of $138,000,000.

Reading, in Berks County, has a population of 96,071, an increase of about 17,000 in the last decade. Reading is distant from Philadelphia 58 miles, one and a half hours' ride by railroad southeast; New York is 128 miles distant, or four hours' ride northeast; Harrisburg, the capital of the State, lies 54 miles west.

In 1748, when the town was laid out by two sons of William Penn, it was already deemed a most advantageous location. In 1752, when it became the shiretown of the newly formed county of Berks, the population was 378. The early settlers were largely Germans, Swedes, English, and Welsh. The Germans gradually increased until they predominated, which condition has continued to the present time. Reading was incorporated as a borough in 1783. At that time the area was 2194 acres, and the population fully 2000, largely composed of Germans. In 1847 it had increased to about 12,000 inhabitants, and was in that year incorporated into a city. Extensions of the city boundaries were made in 1867 and 1869. The present area is 3965 acres, a little more than 6.19 square miles.

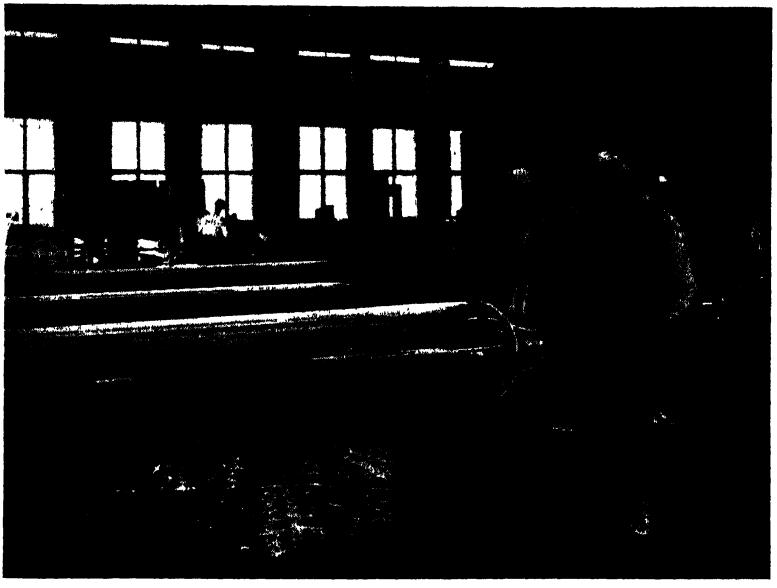
The census of 1850 shows the population to have been 15,743; 1870, 33,930; 1880, 43,278; 1890, 58,661, and 1900, 78,961.

In the matter of steam railroad transportation, shippers have the advantages of two great systems, the Pennsylvania and the Philadelphia and Reading. The diversity of industry is very wide.

One of the important industrial interests consists of the Reading Railway shops. Another large plant is that of the Reading Iron Company. There are several blast furnaces in the city; also stove, hardware, bicycle, automobile, dye, textile, candy, and paint works. The cigar and tobacco industry is strongly developed here, there being 15 leaf tobacco warehouses and 10 tobacco manufacturing establishments. The cigar business is unusually large. No less than 30 factories are in operation. These require nearly $400,000 worth of revenue stamps yearly. The city of Reading has to-day about 500 manufacturing establishments, employing 25,000 people and producing goods of the estimated value of $30,000,000 annually.

Wilkes-Barre is the county seat of Luzerne County. Its population is 67,105, and its mean elevation above the sea level is 552 feet. The city has a total number of industrial plants of 180, employing 8000 workers, and turning out products annually valued at $15,000,000. The mineral wealth in the territory around Wilkes-Barre is very large, the retail value of its annual anthracite coal output being greater than that of the total gold production of the United States. About 60,000 men

and boys are employed in the anthracite mines of the county, and there are about 20,000 employees in the various manufacturing plants. The county ranks next to Philadelphia and Allegheny among the 67 counties of the State in wealth and population, and, in addition to its mining and manufacturing resources, is the third county of the State in agriculture.



CAPPING OFF WINDOW-GLASS CYLINDERS PREPARATORY TO FLATTENING

Because of the mining and manufacturing importance of the district, railroads early entered the Wyoming Valley, in which Wilkes-Barre is located, and the city is now served by no less than eight railroads, in addition to two interurban lines and an excellent trolley system.

There are 13 city banks, with combined capital of $2,950,000, surplus of $6,094,470, and deposits of $22,637,505. These, with 24 suburban banks, have combined capital of $5,225,000, surplus and profits of $9,568,752, and deposits of $45,544,939. Clearings in 1911, city banks exclusively, amounted to $72,354,550.

Erie, in Erie County, which is the next city in point of size, has a population of 66,525. It has shown a consistent advance in population of 12,000 in the decade between 1890 and 1900, and 14,000 in the decade

between 1900 and 1910. It is the only city in Pennsylvania on Lake Erie, and has an excellent natural harbor. The improvement of its harbor by the United States Government, however, has not been commensurate with the improvement of other lake ports. The city has about 391 industrial plants, employing upward of 10,000 workers, and the annual value of production is $31,734,812. Iron industries form the greatest part of this total. Probably more boilers are made in Erie than in any other city in the United States. The General Electric Company of Schenectady is establishing a large branch plant in the city.

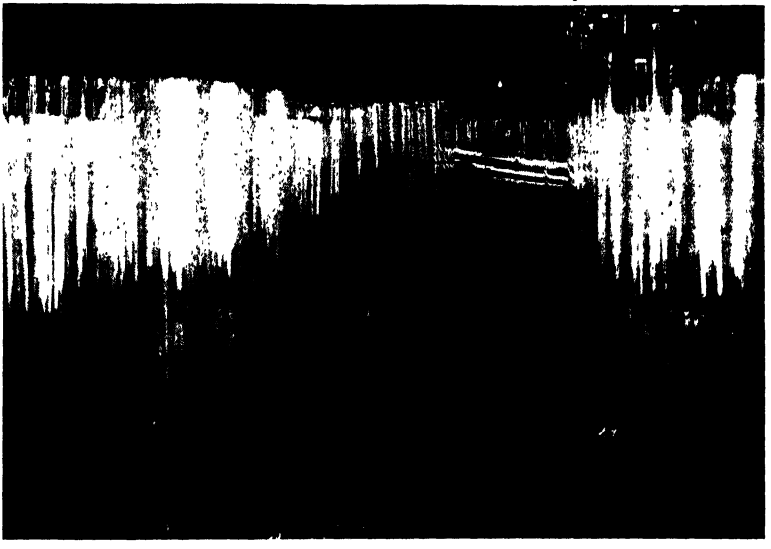
Harrisburg, in Dauphin County, the capital of the State, has a population of 64,186. Between the years 1900 and 1910 it advanced about 14,000. Owing to its position on the Susquehanna and on the main line of the Pennsylvania Railroad between Philadelphia and Pittsburgh, and because of generally good railroad facilities, the city has an excellent industrial position. The Harrisburg Pipe and Pipe Bending Works is the largest plant in its lines of production in the world. The city has 200 industrial plants, employing 13,000 workers. The annual value of production is $22,725,000. Among the leading industries are iron and steel, tin plate, boilers, turbine wheels, book-binding machinery, wheelbarrows, silk, and shoes. The large plant of the Pennsylvania Steel Company is at Steelton, near the city.

In the State Capitol the city has one of the architectural ornaments of the State. The mural decorations by the late Edwin A. Abbey and Violet Oakley, the stained glass windows by George van Ingen, and the groups of statuary by George Gray Barnard, are among the beauties that make this one of the world's notable public buildings.

Another remarkable feature of the building is the Mercer handmade tiling. These tiles, which represent the various products and interests of the State, were made after the old German process, improved by one generation after another of early Pennsylvanians.

Johnstown, in Cambria County, has a population of 55,482, having advanced 20,000 in the last decade. It became known the world over by the great inundation of the last day of May, 1889, known as the Johnstown disaster. The history of the destruction and rebuilding of this city, the metropolis of the Conemaugh Valley, is one of the notable chapters in American history. Fourteen miles from Johnstown was a storage reservoir, on the south fork of the Conemaugh, built originally to increase the supply of water for the Pennsylvania Canal in the dry season. In 1838 the dam was 90 feet high and the lake covered an area of 600 acres.

The embankment stretched across a deep gorge 300 feet above the city. For a week prior to the disaster of May, 1889, there had been a heavy rainfall, with a consequent flood in the Conemaugh. On the 29th the dam was rent and shortly afterward part of the masonry toppled. The flood caused the loss of 3000 lives and a property loss of $15,000,000. The effects of this disaster were wiped out with remarkable energy.



CYLINDERS OF WINDOW-GLASS STORED READY FOR FLATTENING

The principal industry of Johnstown is the Cambria Steel Company. There are in all 97 industrial establishments, employing upward of 10,000 hands and turning out, annually, products valued at nearly $50,000,000. These had an aggregate capital invested amounting to $59,600,000, and annual products of $28,890,000.

Altoona, in Blair County, has a population of 52,127, having increased 24,000 in the last decade. It is on the main line of the Pennsylvania Railroad, near the headwaters of the Juniata River. The lowest ground in the city is 1120 feet above the sea level.

The city of Altoona is a creation of the Pennsylvania Railroad Company, and it has remained essentially a railroad town. The yard, shop sites, and residence lots were laid out in 1849. The erection of the shops was begun in 1850. While none of the original buildings remain, the shops have been continually added to, until they now comprise, taken

together, the largest railroad shops in America. The annual capacity of the present shops is 300 new and 2100 repaired locomotives, 50 new steel and 300 new wooden passenger equipment cars, and 366 new freight equipment cars.

Aside from the Pennsylvania Railroad Company's interests, the only considerable manufacture is silk. However, there are varied small industries, including brick manufactories, book binderies, cigar manufactories, lumber manufactories, and mattress factories. There are 274 establishments, employing 8500 hands, and the annual value of production is $17,000,000.

Allentown, in Lehigh County, has 51,913 population. Since 1890 it has more than doubled in size. It is the shire town of Lehigh County and the metropolis of the Lehigh Valley. The city is 90 miles west of New York City, 57 miles north of Philadelphia, and 30 miles south of the anthracite coal fields of Pennsylvania. It has an elevation of about 417 feet above sea level. The climate is moderated by the influence of the South Mountain, which lies close to its southern border. A report made in 1909 credits the city with 16 silk mills; 10 miscellaneous textiles, employing 1503 hands; four iron industries, employing 1438; three cigar factories, employing 1180; 13 lumber manufactories, employing 906, and 9 leather industries, employing 827.

Allentown is the second largest silk manufacturing center in Pennsylvania, being exceeded only by Scranton, a city of much larger size. About 5000 hands are employed in the silk mills, whose annual product is valued at $10,000,000. The city contains 274 industrial establishments, employing 12,000 people and turning out products valued at $26,000,000 annually.

Lancaster, in Lancaster County, has a population of 47,227. It is located in the center of a rich agricultural district, which has been termed the garden spot of the East. The farm property in this district exceeds $90,000,000. The tobacco crop alone exceeds $3,500,000 annually, while the acreage in potatoes exceeds that of tobacco. The city has an elevation of 418 feet. The total number of industrial plants is 341, the number of workers 8000, the annual value of production $16,000,000. The output of umbrellas, linoleums, toys, and watches is large.

York, in York County, has a population of 44,750, having made a notable advance in the last decade. In diversity of manufacture, it is the third city in the State. There are about 218 industrial plants, employing 12,000 people and having an annual production valued at $18,500,000.

York is one of the oldest and historically one of the most interesting cities in the State. The first National Thanksgiving proclamation was issued at York. The Articles of Confederation were here passed by the Continental Congress. The first printing press west of the Susquehanna River was erected at York, and the first canal west of the Hudson River was opened near the city.

McKeesport, Allegheny County, has a population of 42,694. Situated on the Monongahela River, in the Pittsburgh industrial belt, its 67 plants turn out products annually valued at $42,495,000. The leading lines of output are iron and steel and their products, such as pipe, tubes, tin and terne plate, planished iron, foundry products, tool steel, and steel for projectiles. Among the leading industries are the National Tube Works, an underlying company of the United States Steel Corporation, which comprises among its plants the Monongahela Blast Furnaces, the Monongahela Steel Works, the National Skelp Mills, the National Tube and Pipe Mills, the National Galvanizing Works, and the McKeesport Connecting Railroad. There are also here the United States Tin Plate Works, the McKeesport Tin Plate Works, the Firth-Stirling Steel Works, W. Dewees Wood Sheet Mills, and Fort Pitt Steel Foundry.

Chester, in Delaware County, population 38,537, is, next to Philadelphia, the principal port in the State having access to the Atlantic Ocean. Owing to its advantageous position and with access to the deep channel to the sea, it has attracted many important industries. Its oil-refining industry is extensive, and it has large iron and steel and textile plants. Among the plants are those of the American Steel Foundries. At Eddystone, between Chester and Philadelphia, are the extensive new branch works of the Baldwin Locomotive Company, and the Eddystone Print Works. The city proper has 128 plants, which employ 10,000 people and pay wages amounting to $4,000,000 annually. The annual value of production is $19,000,000.

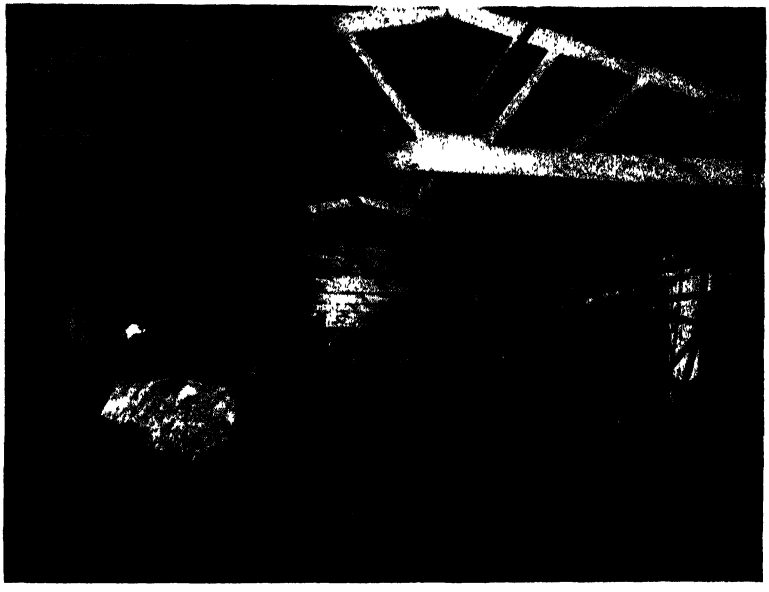
New Castle, in Lawrence County, has 36,280 people. It has much more than tripled its population in 20 years. Located near the center of the rich western tier of Pennsylvania's counties and adjoining the eastern line of the Commonwealth of Ohio, Lawrence County occupies an important and commanding position, geographically and commercially. Being at the head of the Beaver Valley, it is well drained by that stream and its numerous branches, the most important of which are the Shenango and Mahoning Rivers and Neshannock, Conoquenessing, and Slippery Rock Creeks.

Within the county's rather small area of 376 square miles are enormously productive natural resources—extensive deposits of fire clay, limestone and bluestone, and beds of bituminous coal and iron ore. In addition, the soil is fertile and furnishes the rapidly increasing population with an abundance of farm products. Industrially, this city, situated in a district that develops tremendous tonnage, is one of the most active in the Commonwealth. Its tin-plate mills are especially large. The works of the Carnegie Steel Company, which operates 4 blast furnaces, a Bessemer steel plant with 212-ton vessels, and a steel and tin-bar mill, have an annual output of 700,000 tons of pig iron, 660,000 tons of Bessemer ingots, and 600,000 tons of sheet and tin bar. The tin and steel industries give employment to thousands of hands, which, added to the great window-glass and brick plants and the limestone industries of the community, constitute an army of workers 10,000 strong. There are 82 industrial plants, and the value of production is in excess of $38,000,000. Some idea of the proportions annually reached in the various industries may be had from the following figures: Pig iron, 950,000 tons; window glass, 14,000,000 square feet; muck bar, 26,600 tons; skelp, 39,125 tons; brick, 30,000,000; stoves, ranges, etc., 15,000; bolts and nuts, rivets, etc., 180,000 tons; clay, 10,000 tons; limestone, 2,000,000 tons; asphalt blocks, 2,500,000; sand, 10,000 tons; sandstone, 150,000 tons; enameled ware, 6,240,000 pieces; fine chinaware to the total value of $500,000; wooden boxes, 3,000,000; artificial ice, 90,000 tons; wire novelties, 150 tons; finished lumber, 15,500,000 feet. Among many other and varied products are push buttons, car trimmings and hardware specialties, fuse boxes, ship lights, steam pumps, machinery, boilers, castings, blast-furnace jackets, paints and oils, chemicals, pulp plaster, paper, semi-vitreous sanitary ware, pottery and tableware, rolled steel, and a score of minor articles.

Williamsport, in Lycoming County, has a population of 31,860. Including the South Williamsport and Vallamont suburbs, the population is 42,000. The city has an elevation of 528 feet above the level of the sea. There are 159 industrial plants, employing 5641 workers, and producing annually goods valued at $13,348,000. The principal lines of manufacture are furniture, silk, shoes, and steel.

Easton, in Northampton County, with a population of 28,523, has doubled in size in 20 years. Northampton County comprises 382 square miles of land west of the Delaware River, and between the Kittatinny Mountain, the principal mountain on the north, and the South Mountain

on the south. The Delaware and Lehigh Rivers both pass through the mountains in this section, here called the Blue Mountains, by gaps. Northampton was erected during the joint proprietorship of Thomas and Richard Penn, in the spring of 1752. The county and city were both named by Thomas Penn, who in a letter from England in the fall of 1751, wrote: "Some time since I wrote to Dr. Graeme and Mr. Peters



GLAZED KID INDUSTRY

to lay out some ground in the forks of Delaware for a town, which I suppose they have done, or begun to do. I desire it to be called Easton, from my Lord Pomfret's house, and whenever there is a new county, to be called Northampton." The site, subject to the wishes of the proprietaries, was selected by Nicholas Schull, surveyor general, and the town was laid out by William Parsons in the spring of 1752.

The city to-day has excellent railroad facilities, and is connected with the Delaware River, and so with Philadelphia, by the Lehigh Coal and Navigation Canal. Advantages and resources of a wide variety have drawn attention to the Lehigh Valley as a good location for manufactories.

Among the numerous articles manufactured in the city and immediate vicinity are hosiery, silk and cotton goods, cigars, confectionery,

pianos, jewelry, brass and bronze castings, mill and steam fitters' supplies, lumber, fertilizer, wagons, belting, foundry and machine shop products, cement, and serpentine marble. The surrounding hills are rich in brown hematite iron ore, mineral oxides, yellow and brown ochre, limestone, building stone, marble, verdolite, soapstone, brick clay, and sand. There are 126 industrial plants, employing 3200 workers, and the annual value of production is $7,000,000.

Norristown Borough, Montgomery County, has a population of 27,857. It has 111 manufacturing plants, employing 4400 people. The principal industries are knitting machinery, woolens, hosiery, shirts, cigars, cotton goods, lumber, and spinning mills.

Shenandoah Borough is located in the anthracite fields of Schuylkill County, and its people are principally engaged in mining. It has a population of 25,774, and 10,000 work in the mines. The elevation above sea level is 1300 feet. There are 29 industrial establishments.

Hazleton, in Luzerne County, has a population of 25,452. It has 35 industries, employing about 10,000 workers. The value of production, not including the coal mining industry, which is large, is $7,000,000. The principal plants are pump works, iron works, silk and other textile mills.

Butler, in Butler County, is situated in an important tonnage developing district. It has 20,728 people, and is 1077 feet above the sea level. There are 30 industrial plants, employing 7500 and turning out annually products valued at $15,000,000. Leading industries are the Standard Steel Car Works, Standard Plate Glass Works, and Hickson Bedstead Works.

Pottsville Borough, in Schuylkill County, has a population of 20,236. It has 91 industrial plants, employing about 3000 workers and turning out an annual production valued at upward of $9,000,000.

Thriving Smaller Communities

IN ADDITION to these larger communities, Pennsylvania has 41 cities and boroughs having population between 10,000 and 20,000. Of this group, the largest is South Bethlehem Borough.

South Bethlehem Borough, in Northampton County, has a population of 19,973. It has 50 plants, employing 15,000 hands. Among these are the extensive works of the Bethlehem Steel Company, the Didier-March Coke Company, the Bethlehem Foundry and Machine Company, silk and hosiery mills, and wood and paper-box factories.

Shamokin Borough, in Northumberland County, has a population of 19,558. With its immediate suburbs it has a population of 35,000. Being in the anthracite region, mining is its chief industry. It has, however, 39 manufacturing establishments, employing more than 1600 hands, and having an annual production in excess of $3,500,000. In the collieries and manufacturing plants there are employed 16,000.

Braddock Borough, in Allegheny County, has a population of 19,357. The borough contains 41 manufacturing plants, employing upward of 1000 hands and turning out production valued at upward of $5,000,000 annually.

Lebanon, in Lebanon County, has a population of 19,240. It has 109 manufacturing establishments, employing 6000 hands, and the annual value of production is $11,500,000.

Wilkinsburg Borough, in Allegheny County, has a population of 18,924, having advanced in the decade from 11,886. There are 24 manufacturing establishments.

Washington, in Washington County, has a population of 18,778. It is the center of great natural resources. Rich deposits of coal, oil, gas, and limestone have been taken from the hills and valleys of the county, and many millions still lie beneath the soil. Over 160,000,000 tons of coal have been mined in this county, and fully 2,733,000,000 tons remain, which, it is estimated, will take 200 years to mine at the present rate of production. The most important oil and gas development took place in the brief period from early in the year 1884 until late in 1886, when the highest point was reached. Nearly all of the successful wells yielded oil,

though the field has contained a few scattered gas wells. Some oil wells were drilled, which produced 2500 or more barrels per day. The very rapid growth of the town was largely due to this development, which changed the community over night from a quiet college town to a bustling city. To-day the gas activity is principally confined to what is known as the Lone Pine field, where more than sixty-five good-producing wells have been drilled. Drilling is still going on. Only a few oil wells were drilled in the county in 1910. Those in the region of the borough of McDonald are the best producers. Seventy-five industries are located in the borough. More than 4200 men are employed, and $3,000,000 in wages are annually paid to them.

In addition to the vast mineral resources of the region, the soil is fertile. For three-quarters of a century Washington was a great wool-growing county. To-day a clip of 1,000,000 pounds per annum is produced, but the distinction of being the banner wool county of the Union, which was the case for several decades, is no longer enjoyed.

Nanticoke, Luzerne County, has a population of 18,877. Its industries include 10 collieries within a radius of three miles, two silk mills, two hosiery mills, one cigar factory, one machine shop, one mine-drill manufactory, two flour and feed mills. The elevation is 600 feet above sea level. Between 1900 and 1910 Nanticoke made a gain of 55.7 per cent. in population. This was largely due to its enterprise in reaching out after new industries and to the fact of its having cheap fuel supply. It has 17 manufacturing plants.

Homestead, in Allegheny County, has a population of 18,713. Seven miles from Pittsburgh, it is in the great steel-producing district, and its principal plant is that of the Carnegie Steel Company. It is on the lines of the Pennsylvania Railroad and the Pittsburgh and Lake Erie Railroad.

Dunmore, in Lackawanna County, has a population of 17,615, having made a gain of approximately 40 per cent. in the decade. It has 18 industrial plants, employing 1308 wage earners, and the annual value of production is $1,851,000.

Mt. Carmel Borough, in Northumberland County, has a population of 17,532, having advanced from 13,179 in the 1900-1910 decade. Mt. Carmel has 20 manufacturing establishments.

Carbondale, in Lackawanna County, has a population of 17,040. The city is 1300 feet above the sea level. There are 34 industrial plants, employing upward of 1500 workers and turning out product valued at more than $2,500,000 annually. Among the industries aside from coal

PETROLEUM OIL WORKS, ATLANTIC REFINING COMPANY, POINT BREEZE, PHILADELPHIA

IRON MINING IN THE LAKE SUPERIOR REGION

mining are welding works, locomotive shops, iron and brass foundries, car shops, railroad shops, instrument works, flouring mills, mining machinery, broad silk mills, bobbin works, perforated plate works, printeries, throwing mills, planing mills, and refrigerating-machinery works. Three railroads touch the city, the New York, Ontario and Western, the Erie, and the Delaware and Hudson.

Plymouth, Luzerne County, has a population of 16,966. Nearby population increases this to 25,000. There are in the borough eight large anthracite coal mines, hosiery factories, silk mills, and machine works. In all there are 23 manufacturing establishments.

Pittston, in Luzerne County, has 16,267 people, making a gain of about 25 per cent. in the decade. It has 40 manufacturing plants.

Mahanoy City Borough, in Schuylkill, has 15,936 people, showing a creditable advance in the decade. It is one of the important anthracite communities. There are in the borough 33 industrial establishments.

Duquesne Borough, in Allegheny County, has a population of 15,727. Its advance in the decade was very rapid, there being an increase in population of about 60 per cent., owing to its participation in the industrial advance of the Pittsburgh district generally.

Oil City, in Venango County, has a population of 15,657. The rapid advance that it had in the earlier years of oil development has not been equalled in recent years. It has 34 industrial establishments, employing 1338 people, and having an annual value of production in excess of $4,000,000.

Pottstown Borough, in Montgomery County, has a population of 15,599. It has an elevation of 150 feet above the sea level. Its principal industry is its iron works. There are 78 plants, employing over 3600 hands, and the value of production is in excess of $12,500,000.

Sharon Borough, in Mercer County, has a population of 15,270, and showed an advance of 75 per cent. in the decade. It has 45 industrial plants, employing about 3500 hands, and the annual value of production is $10,000,000.

McKees Rocks Borough, situated in one of the busiest sections of Allegheny County, has a population of 14,702, and is the largest among the 23 cities and boroughs in the State of Pennsylvania having populations ranging from 15,000 down to 10,000. The borough is in the Pittsburgh district, and shares in its activity in the iron and steel industry. There are 31 manufacturing establishments.

Bradford, in McKean County, has a population of 14,544. The city is 1550 feet above the sea. It has 82 industrial plants, employing 2350 workers, and having an aggregate production of about $5,000,000.

Steelton, in Dauphin County, has 14,246 people. Its principal industry is the plant of the Pennsylvania Steel Company.

Sunbury, Northumberland County, has 13,770 people. Among its leading industries are the Pennsylvania Railroad shops and Susquehanna silk mills.

Uniontown, Fayette County, has 13,344 people, having almost doubled its population in the ten years from 1900 to 1910.

Greensburg Borough, in Westmoreland County, population 13,012, has the record of having increased its population nearly 100 per cent. in the last decade.

Connellsville, Fayette County, has 12,845 people, 15 plants, 3000 workers. Its leading industries are tin plate, glass, tubing, mining machinery, and pumps.

Bethlehem Borough, in Lehigh and Northampton Counties, has a population of 12,837.

North Braddock Borough, in Allegheny County, has 11,824 people, and has advanced over 80 per cent. in 10 years.

Meadville City, in Crawford County, has 12,780 people. It has 25 industrial plants, employing 2000 people.

Dubois, Clearfield County, has a population of 12,634, an increase of about 30 per cent. in the last decade. Among the manufactories are a tannery, two iron works, machine shops and factory making brass castings, mine, mill, and tannery machinery.

Beaver Falls Borough, in Beaver County, has a population of 12,191.

Chambersburg, Franklin County, has 11,800 people and 12 plants that employ 2400 workers. It is 560 feet above the level of the sea.

Monessen, Westmoreland County, has 11,775 people and six plants that employ 6000 workers. Its leading industries are the Pittsburgh Steel Company and the American Sheet and Tin Plate Company.

West Chester Borough, in Chester County, has a population of 11,767, showing a marked gain in the 10-year period. It is situated in the center of a rich agricultural district. There are in the borough 35 industrial establishments.

Columbia Borough, in Lancaster County, has a population of 11,454.

Old Forge Borough, in Lackawanna County, is credited with an advance of 100 per cent.—from 5630 in 1900 to 11,324 in 1910.

Coatesville, Chester County, has 11,084 population and 15 plants, with 6000 workers. These establishments include the Lukens Iron and Steel Company, which manufactured the first plate iron to be made in the United States. It is an interesting fact that this plant was named after one of the most capable business women that Pennsylvania has produced. It was originally the Brandywine Rolling Mill. Following the death of Dr. Charles Lukens the management devolved upon his wife, Rebecca W. Lukens, who conducted it profitably for two decades. After her death the name was changed as a tribute to her memory.

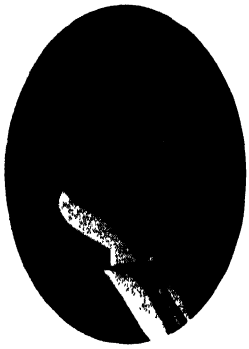
The Worth Bros. Company is another very important Coatesville enterprise. Its output of plates, open-hearth steel, boiler tubes, etc., is extensive.

Warren, in Warren County, has a population of 11,080; 131 industrial plants, employing 1400. The annual value of production is in excess of $4,500,000. The leading industries are iron works and oil refineries. Warren is 1193 feet above sea level.

Phoenixville, Chester County, has a population of 10,743; 31 plants, employing about 3000. The Phoenix Iron Company and Bridge Company are the largest industries.

Carlisle Borough, in Cumberland County, has a population of 10,303; *South Sharon,* in Mercer County, 10,190; *Carnegie,* in Allegheny County, 10,009.

SPECIAL ACTIVITIES OF THE COMMONWEALTH



DR. W. P. WILSON
Chairman Committee on Place of Meeting

THEO KOLISCHER
Chairman Ladies' Committee

EMORY R. JOHNSON
Vice-Chairman Committee on Patrons

EDGAR G. THOMAS
Vice-Chairman Exhibition Committee

MURDOCH KENDRICK
Vice-Chairman Entertainment Committee

SAMUEL L. KENT
Vice-Chairman Committee on Hotel Accommodations

Protection of Health

OF THE many special lines of work which the State conducts for the benefit of its people, the work of reforestation, which conserves one of the first sources of wealth and prosperity, has been treated of under the heading of natural resources.

High in importance among these numerous activities is that which is intended to safeguard the health of the people—the extensive work of the State Department of Health. Figures showing the reduction in the death rate from various diseases, from the time when broad powers were given to the department, are ample testimony to the value and importance of this work. As a result of the control given to the department over the water supply and sewerage systems of the State, there is to-day 60 per cent. less typhoid fever than there was seven years ago, a condition which represents an annual saving to the Commonwealth of approximately $15,000,000. There are in the upland districts of the State many minor watersheds, sparsely populated, whose supplies of water are used by the municipalities in the valleys, where until recently typhoid fever and other water-borne diseases were prevalent. Furthermore, the protection of water supplies by the State extends to the farm, where careless methods of sewage disposal have polluted wells and springs and milk supplies.

In 1906, 56.5 persons out of every 100,000 in Pennsylvania died of typhoid fever; in 1907, 50.3; in 1908, 34.4; in 1910, 24.5. This means that there are now living more than twenty-four hundred persons who, had the death rate of 1906 prevailed in 1910, would have died of typhoid.

Perhaps even more remarkable is the showing made by the department in its fight against tuberculosis. In 1907 a State appropriation of $1,000,000 was made for the purpose of organizing a campaign against the disease. This enabled the department to take over, for use as a sanatorium, a camp that had been established by the State Forestry Department at Mont Alto. This was at once enlarged and plans made for a great sanatorium for incipient and moderately advanced cases. In 1909, $2,000,000 was appropriated for the work, and in 1911, $2,653,000. This enabled the department to increase the size of the Mont Alto Sanatorium.

To-day it has capacity for 1000 patients. One additional sanatorium with large provision for advanced cases is under construction in the Allegheny Mountains, west of the center of the State, on the tract of land presented to the Commonwealth by Andrew Carnegie. Land has been purchased near Hamburg, southeast of the center of the Commonwealth, for a third sanatorium.

From June 1, 1907, to June 30, 1911, 5531 patients were admitted to the State Sanatorium at Mont Alto. Many patients have been discharged with the disease arrested, hundreds have been benefited, and many more whose cases were too far advanced to hope for much aid have been made comfortable and provided with a home where they would not be a source of danger to others.

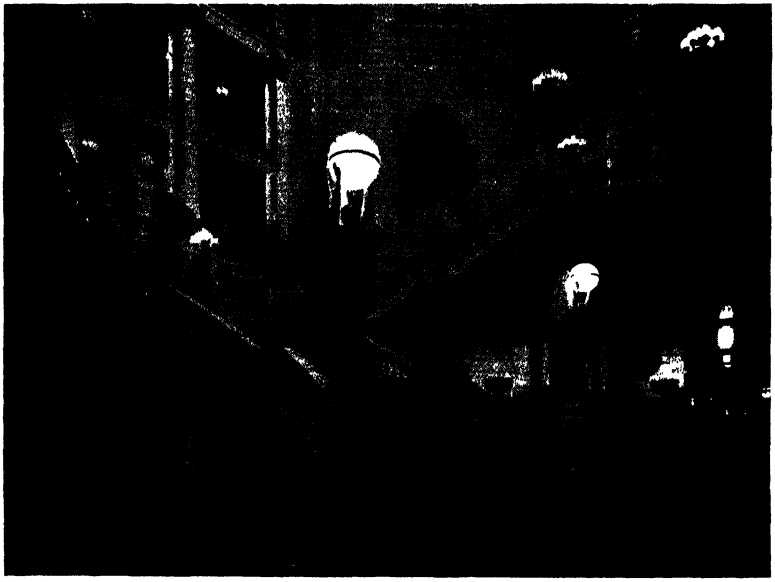
Each large center of population in the Commonwealth is now provided with a tuberculosis dispensary, where the indigent may secure free treatment, free advice, and the usual supplies required to prevent dissemination of the disease, and, in case of great need, eggs and milk. This division at the present time includes a total of 348. The Dispensary Division at first consisted of a chief of dispensaries and a local representative—the county medical inspector—in 67 counties, each in charge of a dispensary. Later these dispensaries were increased to 115 in number and assistants were appointed in many of them. Nurses were soon found to be an essential adjunct to this work, so that to-day, including 115 dispensary chiefs, there is a total of 222 medical men connected with this division and 110 nurses. From July 22, 1907, to June 30, 1911, 41,792 poor tuberculosis sufferers had received the skilled medical aid and the attention of trained nurses. The death rate from pulmonary tuberculosis has fallen from 129.6 per 100,000 to 117.4.

From October, 1905, when the State began its free distribution of diphtheria antitoxin among the poor, down to December, 1910, 27,318 cases of this disease, mostly in children, were treated with the serum. It is estimated that, without antitoxin, 42 out of every 100 of these children would probably have died; but with the aid of the State's antitoxin, only 2324 died, and the death rate was reduced to 8.5 per cent. Free antitoxin was also given for immunization purposes in 20,294 cases, mostly children, who had been in contact with the disease. All but 335 of these were absolutely protected against diphtheria. The actual saving of child life resulting from the State's free distribution of diphtheria antitoxin since 1905 is estimated at 9152 lives.

In administering the laws the Department of Health has perfected

PENNSYLVANIA STATE CAPITOL, HARRISBURG

an organization in the Engineering Division, comprising six bureaus, which has in charge the various matters pertaining to water supplies, sewerage and drainage systems and works, disposal of manufactural and domestic wastes, and the consideration and abatement of nuisances and menaces. In one bureau all applications for the establishment, extensions or alterations to water-works systems and drainage systems are received



ROTUNDA AND GRAND STAIRCASE, PENNSYLVANIA STATE CAPITOL

and considered. The department's engineers make surveys and field investigations with respect to these problems, and upon their reports and the facts submitted by the applicants the permits or decrees are issued. No municipality, corporation, or individual is permitted to build water works and sewer systems or to maintain the same without State supervision and control.

Another bureau looks after the operation of the filter plants used to purify public water-supplies. A corps of assistants constantly travel about, making tests of the filter plants and sewage-treatment works, in order to maintain the standard of efficiency. This saves much water-borne sickness and mortality therefrom. Another bureau deals with all construction

work being done by the department in connection with the sanitary requirements of State institutions, such as water and sewerage, garbage disposal, etc.

Still another bureau controls the sanitary surveys of the minor watersheds of Pennsylvania. Occupied estates on watersheds are inspected by these officials, wells and springs are overhauled, pollutions are stopped. Attention is given to the disposal of sewage at the dairy and truck farm, and thus in its inception there is cut off a source of infection that in the past has made its circuit from the rural districts through the vegetables and the milk and the water to the town, and, from the town, returned back into the country.

Nuisances and complaints that enter into the domain of municipal sanitation and public hygiene are in charge of a separate bureau, while another bureau attends to the general office work and to the preparation of maps and reports and the collection and interpretation of data and analyses of waters. An important part of the work of the department has been the dissemination of information on health questions to the public. This has been accomplished by bulletins, and by enlisting the co-operation of the public press.

Pure Food Crusade

Closely akin to the work of the Department of Health is that of the Dairy and Food Bureau, which in the last few years has worked a revolution in the methods of preparation of food sold to the public. This work is a division of the Department of Agriculture. The enforcement of the law is placed directly in the charge of a Dairy and Food Commissioner. Under the law, the Commissioner and his agents are given full access to all places of business manufacturing, transporting, or selling foods.

During the year 1910 the Dairy and Food authorities caused to be analyzed samples as follows: Milk, 1777; cream, 499; condensed milk, 16; ice cream, 288; cheese, 11; butter, 938; renovated butter, 1; oleomargarine, 283; meat products, 257; lard, 20; eggs, 37; canned fruit and vegetables, 215; catsups, etc., 129; fruit butters, jams, etc., 74; vinegar, 25; bakery products, 122; candy, 336; flavoring extracts, 40; non-alcoholic drinks, 278; miscellaneous, 161.

When first enacted, the food laws were received by many intelligent citizens with some doubt as to their wisdom and necessity. The doubt regarding their wisdom grew largely out of the fact that the prime

responsibility for sales of adulterated and misbranded foods was placed upon the retailer, and it was very generally questioned whether it was either wise or fair to fix the responsibility at this point in the chain of transactions extending from the factory to the hands of the consumer. The public has, however, come generally to understand that the difficulty of securing adequate proof against the jobbers and manufacturers made it necessary to require of the retailer the acceptance of the large responsibility imposed by the law, and that he correspondingly take measures to protect himself by increased care in the purchase of the supplies which he selects for distribution to his customers.

The public education upon the methods of food manufacture, the nature of the raw material employed therein, and the serious character of the frauds which have, in earlier years, been perpetrated upon the buying public have dispelled the doubt as to the necessity of such legislation and have made clear the principle that the man who makes a business of manufacturing on a large scale the foods used to maintain the vigor and health of the people occupies a position of trust.

The extent of public information upon food subjects at the present day, as compared with that of a decade ago, is almost a matter for surprise. To the discovery and spread of this information many agencies have contributed. Most conspicuous of all these agencies has been the public press, to whose live and aggressive support of all measures looking to the more perfect control of food production and distribution a large degree of admiration is due.

The State Highways

BY THE terms of an Act of the Legislature, approved May 31, 1911, the Commonwealth of Pennsylvania is committed to a policy of highway improvement broader than that of any other State in the Union. This act makes provision for the taking over, on June 1, 1912, of highway routes covering 7500 miles, which are to be

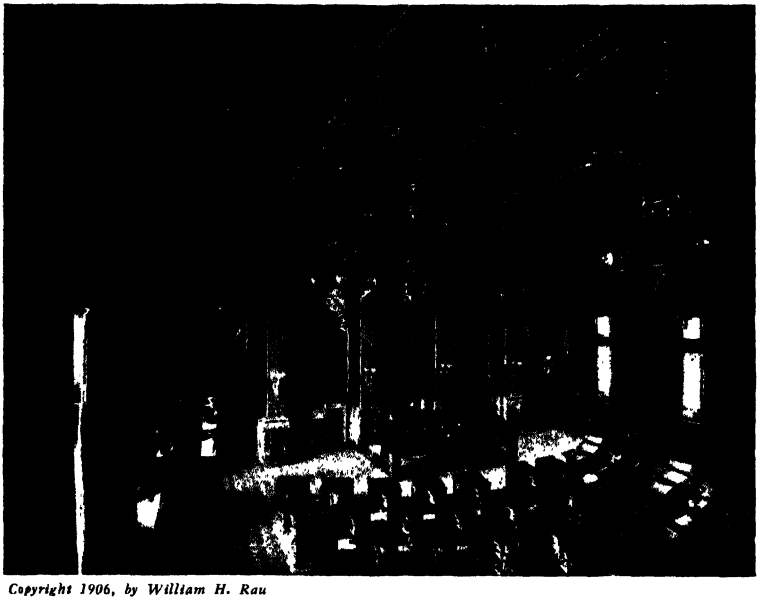
STAGE-COACH AND CONESTOGA WAGON AT ROADSIDE INN

maintained by and under control of the State. The act carried an appropriation of $3,000,000 to be expended on those highways where the State is to pay the entire cost of improvement, and $1,000,000 to be spent on those highways which are to be improved jointly by the State and the township or borough.

Prior to the adoption of this comprehensive plan of improvement the State had provided liberally for the improvement of highways.

There are 97,940 miles of township roads in the State, of which 1580 miles had been improved by townships, 331 miles by counties, and 747 miles with State aid under contract with the State Highway Depart-

ment, at a cost of $8,947,262.91; the State paying three-fourths, the counties one-eighth, and the townships one-eighth of the total cost. The average cost of the completed roads constructed with State aid, including grading, drainage, stone for telford foundation and for macadam top, and bricks for top, together with damages paid for change of location of roads and for engineering and inspection, is $11,375.18 per mile.



SENATE CHAMBER, PENNSYLVANIA STATE CAPITOL

There had been appropriated for reconstruction work $9,500,000, covering the period from June 1, 1903, to May 31, 1911. This amount was apportioned to the several counties—outside of Philadelphia County—according to the number of miles of township roads in a county. Ten per cent. of the appropriation was set aside as a maintenance fund to be apportioned to the townships and counties having improved roads according to the number of miles of roads improved.

Under the new act no less than 296 routes are marked out for improvement. Early in 1912, 50 surveying corps began to make surveys of the roads connecting county seats. All public roads, highways, turnpikes, and toll-roads subject to the provisions of the act, form-

ing and being main traveled roads between the county seats of the counties of the Commonwealth, and main traveled routes leading to the State line, and between principal cities, boroughs, and towns, are to be built, repaired, and maintained at the sole expense of the Commonwealth. They will be under the exclusive authority and jurisdiction of the State Highway Department, and will constitute a system of State highways.

HOUSE OF REPRESENTATIVES CHAMBER, PENNSYLVANIA STATE CAPITOL

The highways designated in the act as State highways are to be taken over by the State Highway Department from the counties or townships of the State, and when so taken over shall thereafter be constructed and maintained at the expense of the Commonwealth. The highways are to be taken over in whole or in part, from time to time, as circumstances and conditions will permit. It is provided that all township roads, abandoned and condemned turnpikes, or turnpikes that may hereafter be abandoned or which may hereafter be condemned and paid for by the county in which the same may be located, and which form a part of any such highways, are to be taken over by the State Highway Department before the first day of June, 1912.

But beyond the improvement to which the State stands committed with regard to this system of State highways, it is to bear an important part in the improvement of the other roads of the State. Counties or townships expressing a desire for State aid in improvement of roads not defined as State highways are entitled to receive such aid. In these cases the State is to pay not more than 50 per cent. of the cost of improvement and maintenance. Of the remaining 50 per cent., in cases where both the county and township ask for aid, they shall each pay one-half, or 25 per cent. of the total cost.

All State highways under the provisions of the act are to be marked with suitable signs, having the words "State Highway" and the year-date. Signs, or distance boards, giving directions to towns or villages, are to be erected at cross or intersecting roads. These are to be paid for as part of the cost of the highway. The State Highway Commissioner may also cause trees to be planted and maintained along highways.

No railroad or street railway is to be hereafter constructed upon any State highway, nor is any railroad or street railway crossing, gas-pipe, water-pipe, electric conduit, or other piping laid in any portion of a State highway, except under such conditions, restrictions, and regulations as may be prescribed by the State Highway Department.

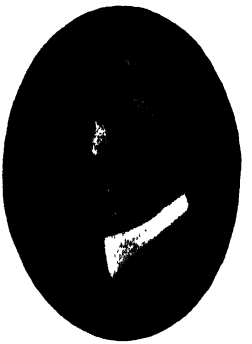
In addition to his other duties, the highway commissioner is to have made surveys of all the roads in the State. He is to make a general highway plan of the State and compile statistics and collect information relative to the mileage, character, and condition of highways. He is to investigate and determine upon the various methods of road construction best adapted to the different sections of the State, and establish standards for the construction and maintenance of highways in various sections, taking into consideration the topography of the country, the natural conditions and the character and availability of road-building material, and the ability of the townships and counties to build and maintain roads.

Before its completion, this comprehensive plan for the improvement of the roads of the State will involve an expenditure of $50,000,000.

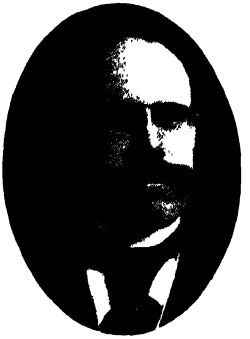
EDUCATION
IN
PENNSYLVANIA

DR. JOSEPH S. NEFF
Director Department of Health and Charities

GEORGE D. PORTER
Director Department of Public Safety



MORRIS L. COOKE
Director Department of Public Works



GEORGE W. NORRIS
Director Department of Wharves, Docks, and Ferries

GEORGE W. McCURDY
President Common Council

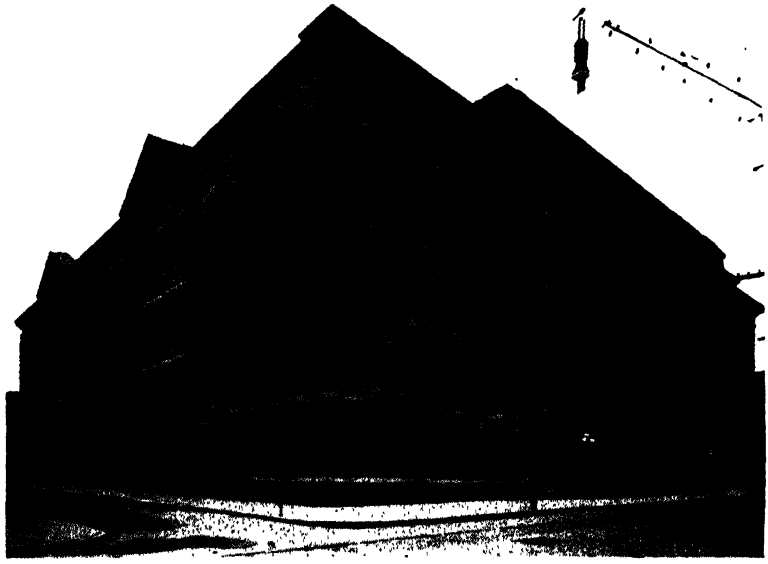
HARRY C. RANSLEY
President Select Council

HERMAN LOEB
Director Department of Supplies

Department Heads and Presidents of Councils, Philadelphia

The State and the Schools

PUBLIC education in Pennsylvania had its beginnings almost with the founding of the colony. There still exists in the city of Philadelphia an institution of learning which was founded in 1689 and chartered in 1697. At the close of the Revolutionary War the attention of the people was turned toward the need of better educational facilities,

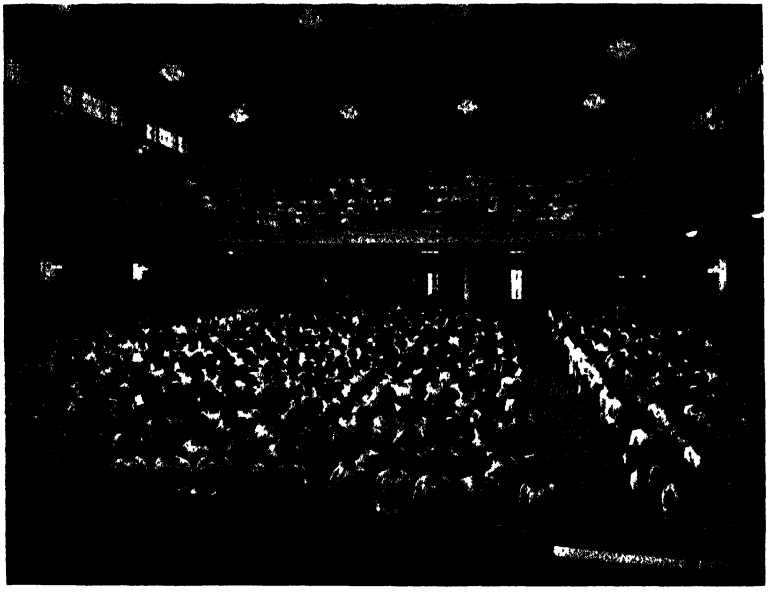


WILLIAM PENN HIGH SCHOOL FOR GIRLS,
PHILADELPHIA

and before the close of the eighteenth century many schools were chartered, which are to-day alive and progressive. Prior to 1834, when the present system of public schools was established, there were, in the State, many sectarian and neighborhood subscription schools where the poor could receive a free education. In 1835, a year after the establishment of the present public-school system, an attempt was made to repeal the law, but already the system was intrenched and the effort was defeated.

Since that day the history of public-school education in Pennsylvania has been one of steady advance.

The past two decades have witnessed an amazing development in the policy of the Commonwealth toward the public schools. Approximately $45,000,000 is spent on public-school education each year within the borders of the State. Of this amount there is contributed from the



AUDITORIUM, WILLIAM PENN HIGH SCHOOL FOR GIRLS, PHILADELPHIA

State treasury $7,500,000 annually. A review of these two decades shows the following advances:

College diplomas have been for the first time recognized in the issuing of teachers' certificates. Text-books and supplies have been furnished free to all pupils. Compulsory attendance laws have been enacted and enforced, giving to each child schooling up to the age of 14 years. The number of high schools has risen from 123 to nearly one thousand. Minimum salary laws have resulted in giving the teachers in the remotest districts in the State better pay than thousands of teachers in New England are receiving. Tuition has been made free in State normal schools and the course of study lengthened to four years. A new school code has been enacted, a Bureau of Professional Education has been estab-

lished, and a Bureau of Medical Education and Licensure has been created in connection with the Department of Public Instruction. The standard of preliminary education for the study of law, medicine, dentistry, and pharmacy has been raised to a high-school education followed by three years of professional study in the case of lawyers and dentists, and by four years of such study in the case of doctors. Throughout the Com-

OPEN-AIR SCHOOL FOR TUBERCULOUS CHILDREN, CITY OF PHILADELPHIA

monwealth handsome edifices for school purposes have been erected, excelling, in point of heating, lighting, ventilation, sanitation, seating, and general comfort, the average home. The State Legislature has appropriated for school purposes more than $150,000,000 as against less than $50,000,000 for all the preceding years.

The State has provided for an expenditure of $15,000,000 every two years for the public schools. After deducting certain general items there is a balance of $6,000,000 to be divided annually, to aid in the cause of public education. One-half of this amount is apportioned on the basis of the number of teachers employed and the other half on the basis of the number of pupils between 6 and 16 years.

The laws of the State provide to-day that the boards of school directors of each school district in the Commonwealth shall purchase all necessary furniture, equipment, text-books, school supplies, and other appliances for use of the public schools, or any department thereof, in their respective districts, and furnish the same free of cost for use in the schools in the districts.

The extent of the public-school system in Pennsylvania is shown by the following statistical statement for the year ending June 5, 1911:

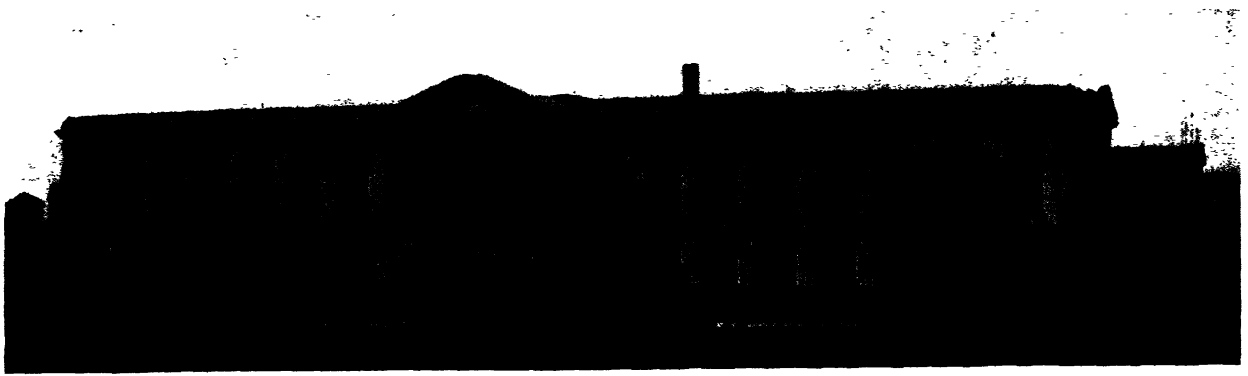
Number of school districts in the State	2,599
Number of schools	35,084
Number of superintendents	171
Number of male teachers	8,044
Number of female teachers	28,136
Whole number of teachers	36,180
Average salary of male teachers per month	$64.24
Average salary of female teachers per month	$47.98
Average length of school term in months	8.52
Whole number of pupils	1,286,273
Average number of pupils in daily attendance	1,028,290
Cost of school houses, building, renting, etc.	$8,794,578.97
Teachers' wages	$20,244,715.69
Cost of school text-books	$858,671.89
Cost of school supplies other than text-books, including maps, globes, etc.	$1,072,188.13
Fuel, contingencies, fees of collectors and other expenses	$11,167,492.69
Total expenditures	$42,137,647.37

In the additions which have been made to the elemental branches of the earlier period, Pennsylvania has kept abreast with the best thought in American education. It was one of the pioneers in manual training, and it is now developing to an important extent its vocational training.

An interesting recent development has been the establishment of out-of-door schools for tuberculous children. On the basis of special investigations in Boston and New York, it is estimated that there are nearly a million school children in the United States to-day who will probably die of tuberculosis before they have reached the age of 18 years, and that one-half, if not three-fourths, of this sickness could be prevented. For such children, open-air schools are needed. Three years ago Philadelphia took the lead among the cities of the State in this work. It has now three schools, one of which is conducted on a roof, another in a room which is open at all four sides, and a third in a room which may be opened to the air when desired, by the lowering of sashes. Not only in the simple matter of keeping these children in the open air, but also in the special care given them, is their physical condition improved. Harrisburg and Pittsburgh have followed in making provisions for schools of this kind.

One of the notable advances of the State in recent years in educational matters has been the gradual raising of the standard of medical education.

MUSEUM OF THE UNIVERSITY OF PENNSYLVANIA



THE COMMERCIAL MUSEUM, PHILADELPHIA. PERMANENT EXHIBITION OF PRODUCTS OF ALL COUNTIES. FOREIGN TRADE BUREAU. LIBRARY OF COMMERCE AND TRAVEL

The Bureau of Professional Education brings Pennsylvania in line with the other States which by authority of law vest in the School Department the power of passing upon the preliminary education of students of medicine, dentistry, and pharmacy. The Bureau, through its representatives, visits the high schools and other schools of equal grade for the purpose of making an accredited list of secondary schools from which credentials will be accepted by the boards of examiners in these branches of professional training. Pennsylvania has an unexcelled system of teachers' institutes, and funds are provided which make it possible to obtain speakers who place before the teachers the latest and best thought on all subjects that have to do with their profession.

An important factor in the general education of the people of the State lies in the many museums and the rich collections with which they have been endowed. Carnegie Institute, at Pittsburgh, has a valuable art collection and a notable natural history museum. Its work in the line of exploration and its natural history researches place it among the leading institutions of its kind. The State Museum, at Harrisburg, is a remarkable exposition of Pennsylvania resources.

Among Philadelphia museums of note are the Pennsylvania Academy of the Fine Arts, the Pennsylvania Museum and School of Industrial Art, the Academy of Natural Sciences, the Wistar Institute of Natural History, and the Wistar Institute of Anatomy. The museums of the University of Pennsylvania are notable for their researches in biblical antiquity and modern ethnology. The Commercial Museum is devoted to the promotion of commerce and to the education of the people along the lines of industry and production. The city of Philadelphia has several notable private art collections, which are eventually to form a public art museum.

Colleges of Pennsylvania

BESIDES having within its borders one of the world's largest universities, Pennsylvania has a large number of important universities and colleges. No State in the Union has a more vigorous group of educational institutions, and the extent to which they have been endowed by Pennsylvanians is proof of a fixed belief in college education that took root in the soil of the State in its earliest days. Pennsylvania colleges have grown steadily in the number of their students and in equipment. To illustrate the advance in number of pupils, Lehigh University has grown in 10 years from less than 400 students to more than 700, State College from less than 300 to 1500, and the University of Pennsylvania has doubled in size, increasing its enrollment from 2500 to more than 5000.

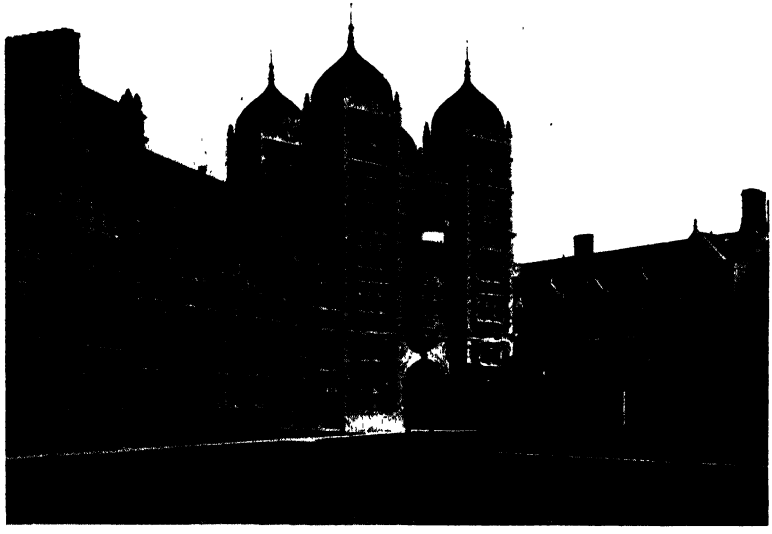
The University of Pennsylvania.—Only 30 of the present American colleges and universities were in existence when the Declaration of Independence was signed, and only six of these were founded more than a century and a half ago. The University of Pennsylvania, which had its origin in a Charity School organized in 1740, was preceded only by Harvard and Yale. Princeton was founded three years later, Washington and Lee in 1749, and Columbia in 1754. Nine years after the Charity School was contemplated Benjamin Franklin published a pamphlet on "The Education of Youth in Pennsylvania," which resulted in the founding of an Academy, which held its first session on January 7, 1751, in the building on the west side of Fourth Street, below Arch, originally constructed for the Charity School. In 1753 the trustees secured their first charter for the Academy, and two years later, by virtue of a second charter, the academy was converted into a college, with full power to confer the usual collegiate degrees. The first commencement was held on May 17, 1757, when the degree of bachelor of arts was conferred upon seven students.

In 1765 a school of medicine, the first in North America, was added to the college, and in 1790 a professorship in law.

In 1779 all the charter rights and privileges of the college were absorbed by a new organization, called in its charter "The Trustees of

the University of the State of Pennsylvania." Thus it was the first institution in North America to be called a university, and including law, medical, and academic departments, the first university in fact.

In 1791 another charter was granted jointly to the trustees of the Charity School and Academy of the University and of the College, under the corporate name of "The University of Pennsylvania," which name it

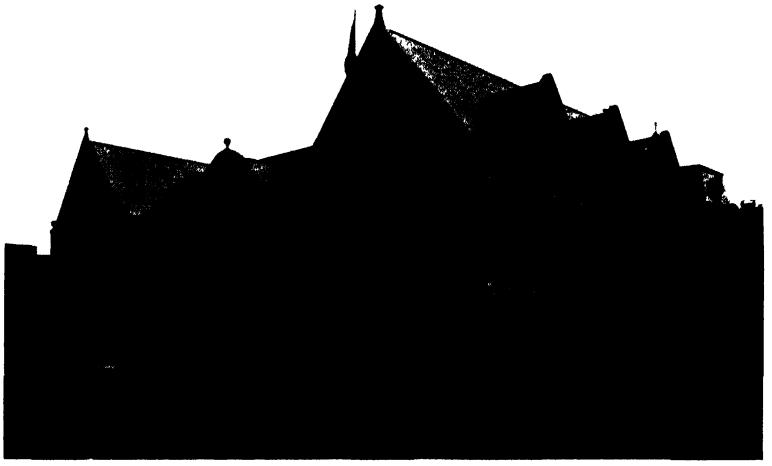


MEMORIAL TOWER AT ENTRANCE TO NEW DORMITORIES, UNIVERSITY OF PENNSYLVANIA

has borne ever since. The early history of the university was closely associated with the principal events in the history of the colonies, and also in the war with Great Britain for independence, in which many of its sons took a leading part. Among the signers of the Declaration of Independence were ten men who were either graduates of the college or among its founders and trustees.

In 1802 the university buildings were removed to Ninth and Chestnut streets, where, a century and a quarter after its organization, the university again found itself located in one of the most congested sections of Philadelphia. In 1873 it removed to its present site in West Philadelphia, where it now occupies more than 70 buildings, upon a tract of 116 acres

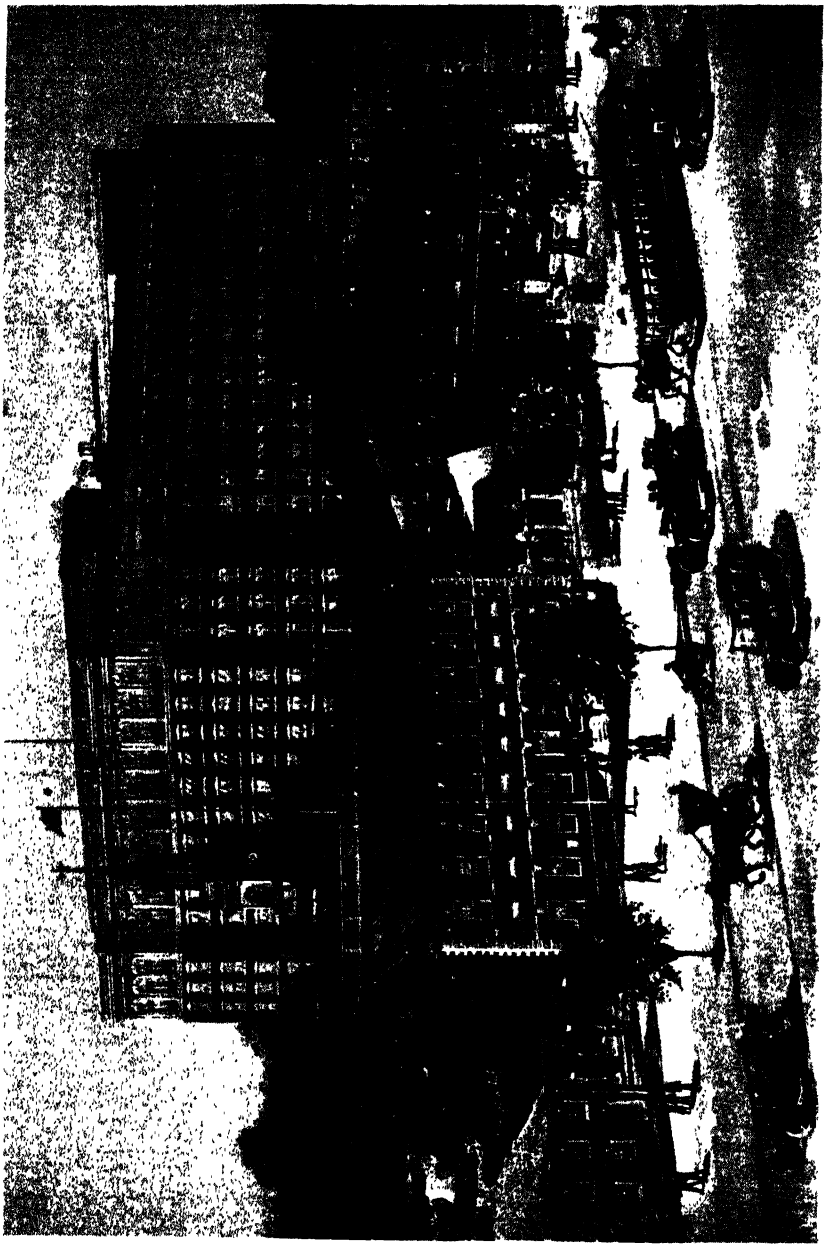
along the Schuylkill River. Here its growth was most remarkable. In 1874 the University Hospital was established. In the year following the Towne Scientific School was added to the college. This school comprehends the courses in architecture, in mechanical engineering, electrical engineering, civil engineering, chemistry, and chemical engineering. In rapid succession followed the Department of Music, Department of



HOUSTON HALL (STUDENTS' CLUBHOUSE), UNIVERSITY OF PENNSYLVANIA

Dentistry, the Wharton School of Finance and Commerce, Department of Philosophy (The Graduate School), Department of Veterinary Medicine, the Veterinary Hospital, the Department of Physical Education, the Department of Archæology and University Museum, General Library, Training School for Nurses, Wistar Institute of Anatomy and Biology, Laboratory of Hygiene, College Courses for Teachers, Flower Astronomical Observatory, Evening School of Accounts and Finance, the Summer School, and the Phipps Institute for the Study, Prevention, and Treatment of Tuberculosis. The curriculum now includes almost every branch of higher education and scientific research.

The enrollment of students averages more than 5000 annually, drawn from 40 to 50 foreign nations, and from every State in the Union. The teaching staff numbers about 600. The 30,000 living alumni are scattered over the entire world, and University of Pennsylvania alumni



INDEPENDENCE HALL AND CURTIS PUBLISHING COMPANY'S BUILDING

societies are flourishing in all large communities. The university is not the growth of a few years, or the gift of a few; it stands to-day as a monument to loyal support of its alumni and the generosity of the city and State and citizens.

The University of Pittsburgh was chartered February 28, 1787, as the Pittsburgh Academy, hence it is one of the oldest institutions of

PLAN OF THE UNIVERSITY OF PITTSBURGH

learning west of the Allegheny Mountains. In 1819 the original charter was enlarged and the name changed to the Western University of Pennsylvania. The State at that time appropriated to the university 40 acres of land in Allegheny, but the title failing, the grant was commuted into money for the erection of the first university building. There are at the university courses of study in medicine, law, dentistry, pharmacy, and engineering, and there is also a School of Astronomy.

The University of Pittsburgh has lately greatly enlarged the scope of its engineering departments, and announced in 1911 the establishment of a new Department of Industrial Research. Industrial researches are being carried out at this university through the sympathetic co-operation of various industrial corporations having important problems for solution. Each industrial research is conducted through a definite agreement between the university and the corporation concerned. The essential features of this agreement are as follows: The corporation has a problem the solution of which is of public importance. It places in the hands of the university a definite sum, which is paid over to the fellow appointed to the investigation in monthly installments. To a discreet and reasonable extent it co-operates with the university toward the solution of this problem by affording large-scale opportunities for experimentation.

The university provides the fellow appointed to the investigation with a laboratory of his own and with all experimental, library, and consultative facilities which a university may be expected to furnish for any

nvestigation. In the case of problems of large scope and importance, the nvestigations are conducted by a group of fellows. Owing to the fact hat of necessity each investigator is a high specialist in the industry :oncerned in his investigation, he is particularly able to instruct the young men desirous of entering that industry as chemical engineer. Hence this nstitution of industrial research will inevitably be a school of chemical engineering, with a staff unique in its numbers and in the scope of its nterests.

The School of Engineering in its co-operative work is a feature of the engineering courses. By this plan the student gets the usual theoretical course, and in addition 12 months of practical work—four terms of three months each in the best engineering industries of Pittsburgh district—accumulating actual shop experience. In the mechanical equipment are included a materials-testing laboratory, a hydraulic laboratory, a steam and power laboratory, dynamo, electrical standardizing and photometrical laboratories. The buildings and equipment at the university are all new. The faculty numbers 250 and there are 1895 students.

The Pennsylvania State College, at State College, was established by the Morrill Act, passed by Congress July 2, 1862, and a reciprocal act of the Legislature of Pennsylvania, April 1, 1863. As early as 1855 a charter had been issued to certain public-spirited citizens under the patronage of the State Board of Agriculture, and in 1859 an institution for secondary agricultural education was opened at the present location under the name of "The Farmers' High School," and the first class was graduated in 1861. Under the new establishment the name was changed in 1874 to The Pennsylvania State College. Some of the trustees are *ex-officio* State officials, others are appointed by the governor, others are chosen by the alumni of the college, and still others are elected by delegates from industrial organizations of the State. The growth was small until 1887, when the State began a regular biennial appropriation to the institution, the total of which to 1911 aggregates $3,565,726.43. The growth in total attendance of students by decades is as follows: 1891, 209; 1901, 433; 1911, 2007.

The present force of instructors numbers 190. No tuition is charged, but preference in admission is given to residents of the State. A very small percentage of the students come from other States and foreign countries. There are five schools—agriculture, engineering, liberal arts, mining, and natural science—also a department in home economics. In these schools 36 courses of study are offered, leading to the bachelor's

degree. Courses are also offered leading to the master's degree. Connected with the School of Agriculture is an experiment station whose projects are connected with problems of animal breeding, agronomy, forestry, horticulture, and dairying. Complete records are available for the fertilizer plots for the last thirty years—probably the longest continuous results obtained in the United States. The School of Engineering

DICKINSON COLLEGE. "OLD WEST"

also maintains an experiment station, in which problems of heating, lighting, refrigeration, aviation, the use of concrete, and the like are under present consideration. Six hundred acres of farm land are owned by the college, part of which is devoted to experimental farming, part to forestry wood lots, and part to campus. The total value of land and buildings is $1,444,369.

Lehigh University was founded by Asa Packer, of Mauch Chunk, who, in 1865, gave $500,000, to which he added 115 acres of land in South Bethlehem, to establish an educational institution in the Lehigh Valley. The university was incorporated by the Legislature by act approved February 9, 1866. In addition to these gifts, made during his lifetime, Judge Packer by his last will gave to the university and its

library an endowment of $2,000,000. The original object of Judge Packer was to afford the young men of the Lehigh Valley a complete education, technical, literary, and scientific, for those professions represented in the development of the peculiar resources of the surrounding region. The courses are arts and science, civil engineering, mechanical engineering, metallurgical engineering, electrometallurgy, mining engineering, electrical engineering, chemistry, chemical engineering.

The university has long recognized the advantage of a broader education for an engineer than is possible within the limitations of the commonly accepted entrance requirements for an engineering course. The number of college graduates who choose engineering as a profession is increasing from year to year. In 1910, 655 students were registered. The college buildings are valued at $1,600,000, and the library, of 125,000 volumes, is valued at $250,000.

Bucknell University, at Lewisburg, a Baptist college, was founded 1846. It is co-educational, and there is an enrollment of 517 men and 229 women students, with 48 instructors. The library, containing 30,500 volumes, is valued at $20,000. The endowment fund is $735,000, while the college buildings are valued at $210,000.

Dickinson College, at Carlisle, was granted a charter by the General Assembly in 1783. Among those who were adherents to the plan for the college were Benjamin Rush, a signer of the Declaration of Independence and surgeon-general of the Revolutionary Army, and John Dickinson, one of the authors of the Declaration and chief magistrate of the State. Among those who contributed liberally to the college during the early days were Thomas Jefferson, Count de la Luzerne, ambassador from France, and seventeen members of Congress. One of the earliest schools for law in the United States was established at Carlisle in 1834 by Hon. John Reed. While under his supervision the school was regarded as part of Dickinson; but at his death the law course ceased to be represented in the college. At a meeting held February 9, 1890, by the Board of Trustees it was voted to again re-establish the School of Law. It now has 77 students. The college is co-educational, and has in all its courses 552 students. It has a library valued at $62,000, containing 43,000 volumes. The buildings are valued at $580,980, and the endowment fund is $387,194.

Temple University, Philadelphia, was organized in 1884, and the charter was granted in 1888. It is a non-sectarian school, with an enrollment in 1910 of 2206 men and 1414 women students. There were,

at that time, 230 instructors. The course has many departments, among them law and medicine. There is connected with the university a library of 8000 volumes. The buildings are valued at $540,000.

Lafayette College, at Easton, received its charter in 1826, at the time of General Lafayette's visit to America. There were enrolled, in 1910, 464 students, with 43 instructors. It has been distinguished from the

PENNSYLVANIA STATE COLLEGE, MAIN BUILDING AND AUDITORIUM

first for the thoroughness of instruction given, particularly in the sciences, mathematics, and the classics. There are 40 acres of campus, with several miles of walks and drives. There are 40 buildings upon the campus, and the value of the property is $866,805. The endowment fund is $613,429.27.

Bryn Mawr, a college for women, located at Bryn Mawr, near Philadelphia, was granted a charter in 1880. There are registered at the college 425 young women, with 58 instructors. The library of 60,000 volumes is valued at $348,620. The buildings are valued at $1,949,191. The college is endowed with $1,644,530.

Grove City College, located at Grove City, was founded in 1876, and the charter was granted in 1879. There are 20 instructors, and during

DELAWARE WATER GAP

the year 1910 400 men and 250 women students were enrolled. The college buildings are valued at $379,000, and there is an endowment fund of $25,000.

Juniata College, at Huntingdon, was chartered in 1878. It is co-educational. There are 24 instructors, with 423 students. The library is valued at $35,000, and contains 28,000 volumes. There is an endowment fund of $115,000, and the college buildings are valued at $170,000.

Washington and Jefferson, Washington, was the first college established west of the Alleghenies. In 1787, Washington Academy was chartered, and later on became Washington College. It united with Jefferson College in 1869, and since then has been known under its present name. In 1790 Benjamin Franklin donated 50 pounds to the institution, which money laid the foundation for the present college library. The college endowment in 1910 was $635,000, and the buildings and grounds have a valuation of $475,000. The present staff of instructors numbers 28, and there are over 400 students, men and women.

St. Vincent College, situated at Beatty, was organized in 1846 and chartered in 1870. It is a Roman Catholic institution. There are 23 instructors and 383 students. There is a library of 45,000 volumes.

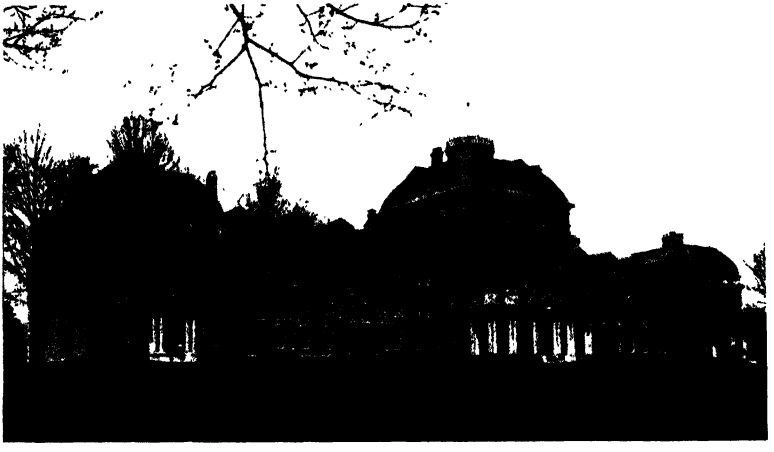
Swarthmore College, Swarthmore, was founded in 1864 by the Society of Friends, but nothing sectarian exists in either instruction or management. It is co-educational, 398 students being enrolled in 1911. There are 45 instructors. Among the courses are those of chemical, mechanical, civil, and electrical engineering. The library, with its 39,085 volumes, is valued at $45,000, and the college buildings at $925,000. The school is heavily endowed, having a fund of $1,010,000.

The Augustinian College of Villa Nova, situated at Villa Nova, near Philadelphia, and founded in 1842, is a Roman Catholic institution. There are 370 students, with 35 instructors. The college buildings are valued at $1,000,000, and the library, with 12,500 volumes, is valued at $125,000.

Wilson College, Chambersburg, was chartered in 1869. It is a college for women, and has 365 students. It has a library of 9000 volumes, valued at $8000, and the value of the buildings, 15 in all, is estimated at about $350,000. There are 36 instructors.

Geneva College, at Beaver Falls, was chartered in 1850. It is co-educational, having 170 men and 188 women students, with a teaching corps of 15. It has an endowment fund of $200,000, and the college buildings are valued at $175,000.

Allegheny College, at Meadville, was founded in 1815 by the Methodist Episcopal denomination. It is co-educational, with 339 students registered in 1910, and having 19 instructors. It is endowed with $465,000, has a library of 31,500 volumes, valued at $60,000, and the college buildings are valued at $544,000.



SWARTHMORE COLLEGE, MAIN BUILDING

Susquehanna University, at Selinsgrove, is a Lutheran School. It has an endowment fund of $55,000, and the buildings are valued at $240,000. It is co-educational, having an enrollment of 317 students. It employs 22 instructors. There is a library valued at $15,000, containing 15,000 volumes.

Pennsylvania College, at Gettysburg, was granted a charter in 1832. It was founded by the Lutherans. It is co-educational, 304 students being enrolled, with 21 instructors. It is endowed with a fund of $195,000, and has a library of 30,052 volumes, valued at $16,000. The buildings are valued at $321,000.

Westminster College, situated at New Wilmington, was chartered in 1852 by United Presbyterians. It has an enrollment of 137 men and 164 women students. There is a teaching force of 23. Its library is valued at $14,000, and the college buildings at $269,500. There is an endowment fund of $163,000.

Waynesburg College, Waynesburg, was founded in 1849. It is a college for men, and has 290 students registered. There are 14 instructors.

It has an endowment fund of $75,000, and the college buildings are valued at $257,000.

Franklin and Marshall College, Lancaster, was formed by the union of two older educational institutions, which in their independent existence labored for common ideals and aims and ministered to a common constituency. Franklin College had been maintained in Lancaster for 45 years, and Marshall College had thrived for 17 years in Mercersburg, when by an act of the Legislature of Pennsylvania they were merged and consolidated under the name of Franklin and Marshall College, to be located in the city of Lancaster, or its immediate vicinity. The charter of Franklin and Marshall College was granted March 10, 1787. Among the first trustees were four signers of the Declaration of Independence, seven officers of the War of the Revolution, three who became governors of Pennsylvania, two distinguished jurists, and two who became senators of the United States. Founded in the interest of Germans, it was never intended to be, as it never became, exclusively a German institution, but it served to foster an appreciation of German life and literature. The enrollment of the college in 1910 was 241. The endowment fund amounts to $303,000.

Lebanon Valley College, Annville, was founded in 1866 by the United Brethren. There are 23 instructors and 132 men and 95 women students. There is an endowment fund of $40,000. The college buildings are valued at $240,000.

Albright College, a United Evangelical institution, is located at Myerstown. It was founded in 1881 and chartered in 1895. It is co-educational, 188 students being enrolled. It is endowed with $100,000.

Beaver College, situated at Beaver, was founded in 1853 by Methodist Episcopalians. It is co-educational, having an enrollment of 160 students, There are 16 instructors. The college is endowed. Buildings are valued at $105,000.

Haverford College, Haverford, was founded in 1833, by the Society of Friends. It has a teaching force of 20, and 159 students. It is very heavily endowed, having a fund of $1,500,000. It has 55,000 volumes in the library. The college buildings are valued at $1,500,000.

Ursinus College, Collegeville, was founded in 1869. It is co-educational, having 95 men and 40 women enrolled, with 16 instructors. The endowment fund is $211,100. The college has a library of 14,000 volumes, and the college buildings are valued at $158,050.

Irving College, at Mechanicsburg, a college for women, was founded

in 1856. It has a teaching force of 18, with an enrollment of 132 students. The college buildings are valued at $100,000.

Muhlenberg College, Allentown, was founded by the Lutherans in 1867. There are 113 students enrolled, with 13 instructors. The college buildings, erected 1902-04, are handsome and artistic, and represent a total valuation of about $350,000. The college occupies now a tract of about 55 acres.

Allentown College for Women is located near the central part of the city of Allentown. Total enrollment is 172.

Pennsylvania College for Women, at Pittsburgh, was founded 1869. There are 18 instructors and 107 women enrolled as students. There is a library valued at $10,000 connected with the college, and the other buildings are valued at $500,000.

Thiel College, founded in 1870, is located at Greenville. It is of the Lutheran denomination, and there are 8 instructors and 60 men and 43 women students. It has an endowment fund of $40,000 and buildings valued at $60,000.

Moravian College, founded in 1807 by Moravians, is located in Bethlehem. There are 6 instructors and 64 men enrolled as students. There is a library of 10,000 volumes. The college has an endowment fund of $115,000, and the buildings are valued at $100,000.

Special Schools and Colleges

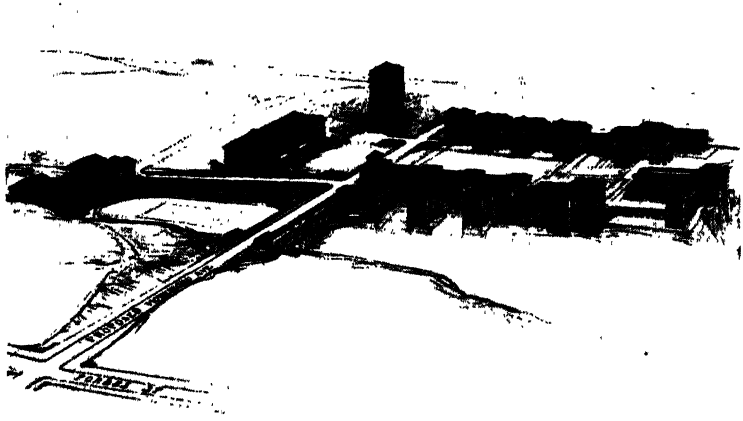
THERE is an increasing tendency, in the founding of new schools in Pennsylvania, to adapt the courses of study to the special needs of the State. This tendency is illustrated in the founding of such institutions as Carnegie Technical Schools and the Thaddeus Stevens Industrial School. And the eminently practical thought of the founders of a number of other institutions is disclosed by a consideration of their purposes.

Carnegie Technical Schools, Pittsburgh, were built and endowed by Andrew Carnegie. The city of Pittsburgh donated a site of 32 acres, and the schools are planned to accommodate 4000 students. There are four separate schools—a School of Applied Science, School of Apprentices and Journeymen, School of Applied Design and a Technical School for Women. There are day and night courses in all the schools. The schools have laboratories, provided with costly equipment for the testing of all building materials, including, stone, brick, cement, concrete, and steel; also a mechanical engineering laboratory, for testing machinery and adjustment of weights and measures.

The laboratories of Carnegie Technical have recently been the scene of a series of exceptionally interesting tests of expanded metal used in concrete construction. Valuable data also has been secured from tests of structural material and of pipe during the last 18 months. The materials-testing and mechanical-engineering laboratory equipment at the school includes apparatus for determining the physical properties of iron, steel, cement, reinforced concrete, stone, brick, wood, and other materials. There are two Olsen standard testing machines, one of 30,000 pounds and the other of 100,000 pounds capacity; two Riehle testing machines of 15,000 pounds capacity each; an Ameler-Laffon hydraulic beam-testing machine for uniformly distributed load, and of 280,000 pounds capacity; an Olsen hydraulic compression-testing machine of 50,000 pounds capacity, for testing building materials; a beam-testing machine of 20,000 pounds capacity, for testing timber; an Ameler-Laffon torsion machine of 1000 foot-pounds capacity; a Brinell hardness-testing machine and a Shore scleroscope for testing the hardness of metals; a Landgraf-Turner alter-

nating impact testing machine; a Riehle abrasion machine, for testing the wearing qualities of building materials; an Olsen abrasion cylinder, for testing paving bricks, and a complete equipment of cement-testing apparatus. The present faculty numbers 160, and the student body 2450.

Girard College, Philadelphia, is among the most notable of the educational institutions of the United States. It was founded under the will

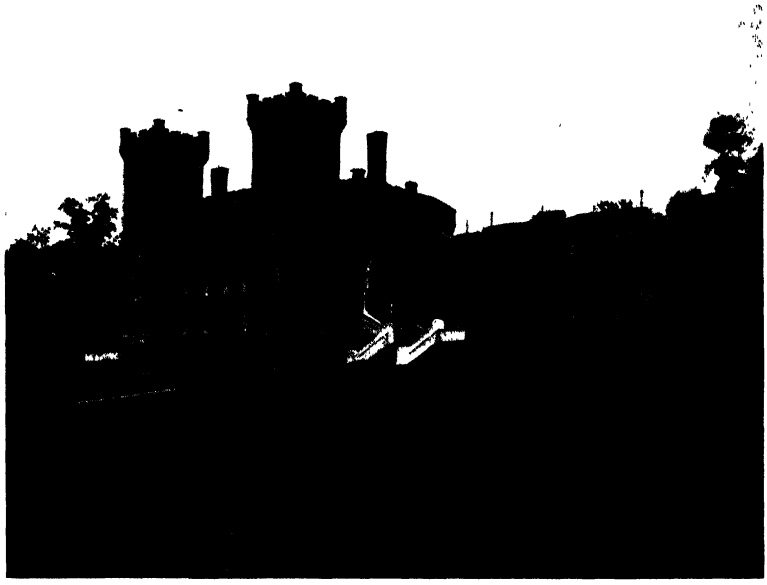


PLAN OF CARNEGIE TECHNICAL SCHOOLS, FOR WHICH MR. CARNEGIE HAS DONATED $8,000,000

of Stephen Girard, and gives a free education to fatherless boys. The extent of this philanthropy is shown by the statement that more than 1500 boys are supported and educated in this college. Many of the boys entering Girard College are so young that they are not able to dress themselves, and they need constant and careful attention for every detail of their lives. They also need "mothering," and that personal interest which can only be given by a governess. There are, therefore, a corps of upward of a score of governesses. These orphans leave Girard with a college education along practical lines, a kit of tools on their back, and money in their pocket.

No provision of the will of Stephen Girard or no fact in connection with the administration of the college is so widely heralded or the cause of so much unfavorable comment as is the prohibition on the part of the founder imposed against the admission of any ordained ecclesiastic, missionary, or minister within the enclosure for any duty or even as a visitor on any premises appropriated for the use of the college. It would

be unfortunate to consider the above prohibition without putting with it the statement which immediately follows in the will—viz.: "In making this restriction, I do not mean to cast any reflection upon any sect or person whatsoever; but, as there is such a multitude of sects, and such a diversity of opinion amongst them, I desire to keep the tender minds of the orphans, who are to derive advantage from this bequest, free from



A VIEW OF LEHIGH UNIVERSITY

the excitements which clashing doctrines and sectarian controversy are so apt to produce; my desire is, that all the instructors and teachers in the college shall take pains to instill into the minds of the scholars *the purest principles of morality,* so that, on their entrance into active life, they may, *from inclination and habit,* evince *benevolence toward their fellow-creatures,* and *a love of truth, sobriety, and industry,* adopting at the same time such religious tenets as their *matured reason* may enable them to prefer."

This prohibition, as well as an earlier one requiring that every person who should ever be employed in the college should be of established moral character, and further, that moral training was to be given, point clearly to the fact that Stephen Girard did not wish an atheistic institution.

BRIG. GEN. WILLIAM H. BIXBY
(Chief of Engineers U. S. A.)
General President

COL. HARRY F. HODGES
(Corps of Engineers U. S. A.)
President 2d Section

BRIG. GEN. C. W. RAYMOND
(U. S. A., Retired)
General President

ELMER L. CORTHELL
President 2d Section

LIEUT. COL. J. C. SANFORD
(Corps of Engineers U. S. A.)
General Secretary

COL. JOHN BOGART
President 1st Section

The total expenditures for Girard College in the year 1910 amounted to $631,579.73.

Drexel Institute, Philadelphia, was founded in 1891, by Anthony J. Drexel, for the promotion of education in art, science, and industry. The chief object of the institute is the extension and improvement of industrial education as a means of opening better and wider avenues of employment to young men and young women. The academic departments provide for the general development and liberal training of the mind and character of the students, and in the more special and technical courses the same end is kept in view, so far as the necessary limitations of the instruction permit. In accordance with the founder's intention, the plan of organization has been made so comprehensive as to provide liberal means of culture for the masses, by means of evening classes in all the departments of the institute; by free public lectures and concerts during the winter months; and through the library, museum, and picture gallery, which are open free to the public throughout the year. There is a total enrollment of 2600, of whom 1000 are day pupils and 1600 evening pupils.

The Thaddeus Stevens Industrial School of Pennsylvania, Lancaster, was founded by Thaddeus Stevens, who made a bequest for the education of deserving boys in trades and industrial pursuits. By the year 1903 this fund had accumulated to a sum not far from $70,000. On January 31, 1905, a bill for the founding of the Thaddeus Stevens Industrial School was introduced into the Legislature, which was passed without a dissenting vote, carrying an appropriation of $50,000. In 1907 another appropriation of $100,000 was secured by a unanimous vote, and in 1909 an appropriation of $40,000 was passed for maintenance. The directors of the poor of Lancaster County donated 25 acres as a site for the school. The purpose of the school is to give poor and deserving boys a good English education and to train them in habits of morality, economy and industry, and to teach them mechanical trades. Preference in admission is given: First, to indigent orphans; second, to other orphans; third, to poor boys at large.

The superintendents, teachers, and pupils of the public schools of Pennsylvania contributed $11,575.38 toward the establishment of the school. This contribution was evidence of the appreciation of the services of Mr. Stevens in saving the common school law from repeal in 1835. The school differs radically from a manual training high school. The pupil learns a trade thoroughly, and on graduation takes his place as a skilled workman in the industrial activities of the country. The education

which is here given is designed to fit the graduates to become foremen in the several trades which they have chosen.

Carlisle Indian School is located at Carlisle, 19 miles from Harrisburg. The school was originally cavalry barracks, and here, in 1775, Franklin made a treaty of peace with the Indians. During the Revolutionary War Hessians were kept prisoners here, and during that time they built a large stone guard house of unique construction, which is still standing. It was donated in 1879 by the Interior Department for the purpose of beginning an educational establishment for Indians. This was the first school of its kind to be opened by the Government, and the first to receive Congressional recognition and appropriation. It was opened on October 6, 1879, when 82 Indians arrived from the Sioux reservation. The second party, containing 47 Indians, came the following November. The school is supported by the Federal Government, and it has been specifically provided for by Congress since 1883.

The purpose is to train Indian youth of both sexes to take upon themselves the duties of citizenship. The plant consists of 50 buildings and 311 acres of land. The school campus has 26 acres. Both boys and girls are taught here, and board and clothing is furnished to all students. There is absolute freedom as to the religious belief of each student. The students publish and print a weekly newspaper, *The Carlisle Arrow;* also a monthly magazine, *The Red Man*. The government of the boys is military only so far as is necessary. M. Friedman is the superintendent, and James E. Henderson is commandant of cadets. The boys have a band of 40 members, and seven troops of dismounted cavalry. There are at present 1218 students enrolled, coming from 87 tribes. The boys are taught all trades, even photography, while the girls are especially trained in housekeeping, nursing, and sewing.

Carlisle has 291 workers in the Indian service. Last year, 1911, under the Department of Indian Employment, the Indians earned $374,783.40. Out of the total of 514 graduates, only five have been so-called failures; the rest have made a marked success in the careers they have chosen.

One of the most successful enterprises which the Government conducts in connection with the Indian service is the work of finding employment for Indians both old and young. This system is an outgrowth of the Outing System at Carlisle. Under this system the girls are sent into carefully selected homes during the winter and summer months.

The young men go into homes in a similar way, working on farms and imbibing the best forms of civilization. In the last two years a large number of students have been sent out to work with contractors, in shops and manufacturing establishments. Gratifying results have been obtained in extending the system to the entire Indian field. Under its jurisdiction the Indians have demonstrated that they have real mechanical ingenuity, and are being employed in factories and by some of the largest railroads of the country.

The Carlisle School has always enjoyed close co-operation from the State of Pennsylvania. During the last few years the State authorities have united with the school in bringing to perfection certain lines of its work. The State Bureau of Agriculture has sent regularly its experts to assist in developing the orchard work in connection with the farms. The State Bureau of Fisheries has placed thousands of young fish in the school's spring. A number of students have been admitted, without charge, to the Mont Alto Sanatorium for treating incipient tuberculosis. The United States Department of Agriculture has assisted the school in its problems of drainage and farm management, and the Department of Agriculture has detailed an expert to assist and advise in connection with the farms and daily work at the school. This has resulted in marked improvement of the two school farms and the dairy.

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